Alice Whitaker
31 Church St
Bromley

2.7.13

HANDWORK AS AN EDUCATIONAL MEDIUM

AND OTHER ESSAYS.

HANDWORK AS AN EDUCATIONAL MEDIUM

AND OTHER ESSAYS.

BY

P. B. BALLARD, M.A. (Lond.),

Gold Medallist in Mental and Moral Science.

LONDON
SWAN SONNENSCHEIN & Co., LIM.
25, HIGH STREET, BLOOMSBURY, W.C.
1910.

TO

MY WIFE.

PREFACE.

THESE essays are primarily intended for teachers. Four of them, in fact, were read before various Conferences of Teachers in almost the precise form in which they appear in this book. I have aimed at presenting in as lucid and stimulating a way as I can an aspect of education which is coming more and more clearly into view in the educational Renaissance we are witnessing at the present time. There has been in the minds of many of us who are intimately concerned with education a steadily growing conviction that the side of school work that specially needs strengthening is the expressional as distinct from the receptive. The child should do more for himself: he should have fuller opportunity of exercising his natural tendency to plan, to manipulate, and to construct. It is far more important that the teacher should believe this, and that he should understand the principles of dynamic education, than that he should be presented with a ready-made scheme and be advised to put that scheme into operation. More space has therefore been devoted here to the discussion of

principles than to the detailed application of those principles. Indeed, the teacher who expects to find in these essays a complete series of practical "tips" will be no less disappointed than the student who hopes to find material presented in a compact and neatly labelled form readily producible at examinations.

The enthusiasm for education has, in England at least, never been so great as it is at the present time. New sciences are constantly being pressed into her service, and anybody who has a word to say that can throw light upon any of her problems is listened to with patience and respect. Of these lay advisers none has rendered greater service than the physiologist. He has, in the first half of this book, been laid under heavy contribution; for physiological facts form the basis of the main arguments by which I try to trace the connection between handwork and intelligence. Some of these facts, such as those bearing on the localization of function in the brain, are of quite recent discovery, and certain of the details are not so firmly established as to be quite out of danger of being discredited by further research. I therefore reserve the right to alter my opinion on some of the questions raised in this book. The change in the attitude of the medical profession towards ambidexterity is a case in point. Many a physician who ten years ago was in favour of ambidexterity, is to-day against it. The doctrine of unilateral speech centres brought about the decisive dip of the beam.

I would warn the reader against inferring from the general tone and temper of these essays that they are based upon a materialistic creed—that I try to explain

higher things by means of lower. As a matter of fact I make no attempt to offer an ultimate explanation. If I did I should certainly not seek it in matter and motion. I prefer to believe that the source of all our experiences is spiritual, and to regard cerebral conditions as constituting an opportunity rather than a cause—an opportunity for the manifestation of consciousness—an opening through which something pre-existent shows itself. It is because the providing of this opportunity is so largely within our control that so much stress is laid upon it in this book.

My thanks are due to Dr. F. W. Mott who has been kind enough to look through the manuscript of the chapter on Ambidexterity and to give me the benefit of his views on the subject. While agreeing generally with my conclusions, he attaches more importance than I have ascribed in my essay, to the functions of the right cerebral hemisphere. He regards it as a silent partner which participates in every thought, feeling and volition. It creates an equal share of bio-chemical energy, which it hands over to the initiating partner for distribution to the lower centres. In an interesting lecture recently delivered at the Royal Institution he adduced certain facts connected with Apraxia and left-handed mirror writing which lend strong support to his views.

To indicate the books I have plundered would be an impossible task. I will merely say that the author to whom I am most deeply indebted is Dr. William James, for whose genius I have a great admiration.

I have to acknowledge my obligation to the editors and proprietors of the journals mentioned below for their

kind permission to include articles which have been published in their papers. "Pitfalls in the Teaching of Arithmetic" appeared in the "Idola Pulpitorum" series in the *Journal of Education;* the "Teaching of Algebra" in the *School World;* "The Fundamental School Subjects" in the *Teachers' Times;* and "The Neglected Middle" in *Manual Training* under the title of "Manual Training in the Lower Standards."

P. B. BALLARD.

Dulwich.
February, 1910.

CONTENTS.

I.

THE EDUCATIONAL SIGNIFICANCE OF BODILY MOVEMENT.

THE main characteristic of a small boy in good health is that he is always on the move. This physical restlessness could not have escaped the notice of even the most casual observer, but until recent years little significance was attached to it. Most people regarded it as one of the inevitable nuisances of life; there were many who thought it had something to do with original sin; there were but few who suspected that it had any bearing upon the gradual development of thinking power. Yet the one salient and indisputable fact standing forth out of the welter of detail supplied us in the numerous modern books on child study is that the movements of the child are in some way connected with his mental growth. As his movements become more complex his mental processes become more clear and definite. Indeed, the movements of his body seem to be essential factors in the development of his mind.

It was not always thought so. The educational value of bodily activities is a discovery of the Nineteenth Century. It is true that we find in the earlier writers —notably in Comenius—sporadic references to educational handwork, but it was not until the doctrine of Rousseau had filtered through the minds of Pestalozzi and Froebel, who early in the century clearly formulated the doctrine that the child learns by doing, that the principles of motor activity obtained sufficient recognition to affect professional practice; and it was not

until near the close of the century that those principles were put upon a firm basis of scientific proof. The popular tendency has always been to identify education with book-learning. The man in the street thinks of a school as a place where the children sit perfectly still—or at least ought to sit perfectly still—either poring over text-books or listening to the learned talk of a bald-headed gentleman in spectacles. The mother thinks that when her little girl runs about the house and climbs over the furniture she is very naughty, and when she sits still she is very good. The father thinks that when his boy is making a rabbit-hutch or exploring the neighbouring woodland he is wasting his time; but when he sits indoors cramming up a Latin Grammar he is laying the foundation of a brilliant future. The most they can say of the boy actively engaged in games, or the pursuit of hobbies in the open air, is that he is gaining health, and that if he is not learning he is at least not loafing. The whole tendency has been to associate learning with sitting still.

The doctor's patients have a much stronger belief in the efficacy of drugs than the doctor himself, and the average parent has profounder confidence in the educative value of books than the teacher himself. And, as the modern physician tends more and more to recognise that it is Nature that cures, so does the modern educator tend more and more to recognise that it is Nature that teaches; that learning is a spontaneous process which no lack of schooling can stop, and no extent of schooling can do more than modify. The study of this process provides the soundest basis for a theory of education, and of this process muscular activities are inseverably a part.

That the true significance of physical activities in the young should have escaped popular notice is not surprising; but that it should have escaped the notice of the psychologist calls for comment. The older psychologist confined himself almost exclusively to one method —the method of introspection. He looked into his own mind and tried to describe what he found there. He found there what he looked for—ideas; and he tried to analyse these ideas into elements derived from the five senses. Volition, which seemed to consist in a mysterious putting forth of power by the ego, and emotion with its vague admixture of pleasure and pain, resisted his attempts at analysis. The consequence was that he always examined the mind of an adult and never the mind of a child; that he was more concerned with mental products than with mental growth; that he emphasised the intellectual aspect of the mind to the neglect of the volitional and emotional; and that he refused to seek any help from physiology. In his search for ultimate elements, and his desire to refer those elements to the five senses recognised by tradition, it will readily be seen how motor or kinæsthetic sensations were either entirely overlooked, or vaguely referred to the sense of touch. Their intellectual value was completely missed. These sensations of movement, it will be observed, are modest creatures who never force themselves before the footlights of consciousness. As soon as their work is done, as soon as they have fixed a habit, they descend to the region of the subconscious. To discover them, and fully realise the services they render, is a task that has been left to the more modern psychologist; and the knowledge thus gained has been brought to bear on the study of the child. But in doing

this—in applying this knowledge—it is not quite certain that we have escaped the ancient pitfall. The inadequacy of the older psychology arose mainly from the fact that it was exclusively concerned with the adult mind. In the study of this mind certain more or less artificial categories of faculties and senses were arrived at, and in applying these categories to the mind of the child are we quite sure that our procedure is logically sound? Do we not read into the mind of the young child what is only true of the mind of the adult? When, for instance, a man bursts into tears we infer—and rightly infer—that his emotions are violently stirred; but are we justified in assuming that the same is true when a baby cries? We take it for granted that the same overt movement—the same expression—is an index of the same mental state, whether in the nebulous mind of the young child or in the highly organised mind of the adult. Dr. Dewey's view that such an assumption is quite unwarranted may safely be accepted. We want some other principle of explanation in studying the development of the young mind. The mere cataloguing of first occurrences—when the baby first smiled, or clenched his little fist, or changed the character of his cry—is of little use to us unless we can find out what these acts really express—what sort of mentality lies behind them.*

We are well within the realm of fact when we say that the child's movements, his nervous system, and his mind develop side by side. As he grows older his movements become more purposeful, more efficient, better co-ordinated, and better adapted to meet the needs of his widening experience. At the same time his nervous

* See King's "Psychology of Child Development."

system is getting more and more complex, new connections are being established between sensory and motor nerves, new lines of traffic are being set up between the higher and lower nerve centres. Parallel with this increase in neural complexity we find a corresponding increase in mental complexity. Are we justified in assuming that these three things—bodily activity, nervous system and mental structure—grow at precisely the same pace ? Does the development of one necessarily mean an equal development in the other two ? Roughly speaking, it does—in the early stages at least. It must, however, be interpreted dynamically ; they *grow* together. Complexity of neural structure may or may not signify complexity of mental structure ; it depends upon whether the former complexity is inherited or acquired. A man is richly endowed in brain and nerves when the arrangements and associations therein are adequate to meet the various demands of the environment. Some of these arrangements are born with him ; they subserve reflex and instinctive movements. Others were established by himself in the attempt to make his movement purposive and effective. In other words, some of his neural wealth is inherited and some acquired. It is only his acquired neural wealth that indicates mental wealth. Before we can tell how much intelligence or emotion is behind a certain complex movement we must first find out whether that movement is instinctive or not. We have no right at all to assume that the stereotyped neural arrangements in the bee subtend the same mental angle as an equally complex neural arrangement in the boy ; nor yet that two equally well organised bits of neural machinery in the boy possess equal mental significance.

The one characteristic common to all movements is that they are caused by stimuli, these stimuli coming either from within or from without the organism ; and the aim and purpose of the movement is to deal in some way with the stimulus—to remove it if harmful, to retain it if beneficial, to modify it so as to satisfy some need of the organism. In the case of reflex and instinctive responses the neural mechanism is in perfect working order : it goes of its own accord, it needs no interference from a guiding intelligence. But the baby is born with a comparatively small number of these fixed paths of motor discharge, and the most that can be said of the bulk of his instincts is that the physiological arrangements show a *tendency* to take a certain form, but are capable of ample modifications. They are only *partly* fixed. In the majority of cases, however, there are no pre-arrangements at all for dealing with the situation. The baby responds to the stimuli, but the response is ineffective. The nervous excitement being drained off by the most permeable channels, the resulting movements are generally wide of the mark. They fail to bring about adaptation : they do not meet the case. Sometimes he responds with his whole body. It is only by experiment that he finds out which movements are really effective. The wrong movements and the unnecessary movements gradually get left out, and the right response by repetition gradually gets stamped in. It frequently happens, too, that in order to secure more adequate adaptation he has to break up some of the older systems ; that he has to inhibit—to check certain responses and substitute other ones, and these activities of inhibition and guidance are perhaps the most important of all. The operator at the central exchange—

the intelligence controlling the brain-centre—gets more and more practice in switching the nerve currents from inappropriate to appropriate lines of motor discharge. But for this constant vigilance at the central exchange we should soon degenerate into mere automata. For every movement we make leaves its trace in the nervous system, and every repetition tends to deepen that trace. The action gets more and more stereotyped until at last the nerve resistance vanishes, and a habit is fully formed. It is thus seen that we gradually construct our habitual lines of activity out of random impulses. The sensori-motor reaction is the starting point of all the complex muscular adaptations of which we are capable. We start our lives with a small number of ready-made habits which we call reflexes and instincts, and spend our lives in adding to the inherited stock by making for ourselves new ones. The raw material of the new habits consists of random movements, and movements got by the disintegration of old habits. And in this important fact, that we can break up old habits and build up new ones, consists our educability. So long as there is constant interference with the couplings in the brain—so long as there is activity at the central exchange—so long is there resistance offered to that fatal drift into old-fogeyism against which we are warned by William James. And activity at the central exchange means intensity of consciousness. Let us, for instance, consider what happens when a child acquires skill in a simple operation such as knitting. She has at first to attend very closely to what she is doing. She makes wrong movements, finds them ineffectual and tries others. At last she succeeds in making the first stitch. The next few stitches she finds some-

what easier, but she cannot for a moment take her mind off her work. If she does she is certain to make a mistake. But as time goes on the stitches get easier and easier, and she is gradually able to relax her attention. Ultimately she will be able to carry on the process without thinking about it all. The act has become automatic. The amount of attention required has been gradually diminishing, while the automatism acquired has been gradually increasing. And attention merely means the mind at work: it means vigilance at the central exchange: it means intensity of consciousness. Using the term function in its mathematical sense, it becomes clear from what I have said that, as far as the child is concerned at least, the mind is a function of motor activity. Growth in the one is accompanied by growth in the other. It is obvious that activity of mind is not necessary in the case of automatic movements—whether in the form of instincts or acquired habits—for these can go on by themselves; and, in accordance with the general economy of nature, it is probable that where it is not necessary it does not exist. But it *is* necessary—it is indispensable—when new situations have to be met, and new connections made in the brain. And it is just here, where one would naturally expect to find mental activity and growth, that one actually does find it. Whenever bodily movements are under control, whenever, that is, one of several equally permeable channels of discharge is chosen as securing a better adaptation, there do we find intelligence at work. The reflex arc may be regarded as the basal type of all neural activity. Sense stimulation, central reflection and motor response are the essential stages of the reflex process, and it is with the

second stage that consciousness is functionally connected. In course of years the simple reflex arc becomes so elaborated that its essentially triadic nature is lost sight of. Labelling its constituent parts A, B, and C, we frequently find B conspicuously present and A or C conspicuously absent. I resolve to go to church : A is missing. I sit and listen to the sermon : C is missing. But this truncation is more apparent than real. My resolve to go to church is the ultimate result of a complex of sense stimulations received long ago ; and the sermon, if I have listened to it with any profit, will in some way affect my future conduct. A, B, and C may be separated by long intervals of time, they may be intricately tangled with a, b, and c and with α, β and γ; B may swell to inordinate proportions and seem to hold the stage alone ; but if the mind is to act normally and healthily A, B, and C must all play their proper parts. The mind is no salt water lake without an outlet for the incoming streams, but a mountain tarn whose waters are kept sweet by the outflow towards the sea. Consciousness is teleological ; it has an end, and its end is action. Man is not a thinking animal that happens to feel and act, but is essentially a behaving animal that happens to think and feel. The thinking and the feeling are there for the sake of the doing, and action is the legitimate goal of all thought.* It will thus be seen that from the cradle to the grave physical activity takes a leading part in the drama of life. In the earliest years of childhood thought and feeling have no independent existence ; they come into being as a function of movement. In later life, when they seem capable of

* See the essay on "Reflex Action and Theism" in James's "Will to Believe."

cutting themselves aloof from bodily movement, closer scrutiny shows that the severance is never complete, and that such severance as does take place is always fraught with danger to the mental and moral health. All ideas tend to work themselves out in some form of action. If they do not seem to do so it is either because the innervation of the muscles is so slight that the expressive movement escapes our notice, or because the movement is checked or inhibited in some way—which inhibition is in itself a form of motor discharge. Thought must express itself, and so must feeling. An emotion that does not express itself is, if the James-Lange theory is sound, no emotion at all. If the expression is not perceptible to the outside observer it is because it takes the hidden form of subtle changes in the glands and muscles, the feel of which changes as they occur *is* the emotion.

But these immediate and direct responses are the mere inevitable overflowings of a pent-up stream, and are quite inadequate to preserve that balance between income and output upon which perfect sanity depends. The sentimentalist who sheds ineffectual tears over imaginary sorrows and never lifts his finger to relieve the real sorrows of the world is a moral invalid whose disease is all the more insidious in that he knows not that it is there. And the thinker who spends a futile life in pondering over the riddles of the universe with no incentive but intellectual pride or idle curiosity, who devotes no part of his intellectual store to the service of his fellow-man, almost inevitably strays into the wilderness of Pessimism. No optimistic philosopher ever resigned himself utterly to the luxury of contemplation, and, as David Strauss observed: "Every

true philosophy is naturally optimistic, or else she hews down the branch on which she herself is sitting."* Truth is good and useful, as it enriches or ennobles life; but Pessimism," if it is true, differs from other truths by its uselessness."† The phrase, "To love learning for learning's sake" is either meaningless or mischievous. It is meaningless if it is intended to explain our love for learning, for it is equivalent to saying that we love it because we love it. It is mischievous if it implies the doctrine that learning is in itself a legitimate goal of human endeavour. Action is an essential factor not merely in the development of intellect but also in the formation of character. To attempt to mould a character without taking bodily activities into account is worse than trying to make bricks without straw: it is trying to make bricks without clay. For acts and habits constitute the very stuff of which character is made.

In the co-ordination of movements to serve practical purposes the boy's mind is born and nurtured, and in the exercise of this function he finds his greatest happiness. His activities absorb his whole interest. A boy is always keen on doing things, but has little aptitude for abstract thought. A recent writer has pointed out that if a boy is put into a room to be good, and not allowed to move or speak, he will not fall to thinking; he will simply fall asleep. If he cannot be allowed to do something himself, the next best thing, he thinks, is to get something done to him. Bishop Walsham How tells us that on a visit to one of his parishes he

* Quoted by Dr. W. L. Courtney in his "Constructive Ethics."

† Quoted by Professor Muirhead in "The Elements of Ethics."

came across a boy, aged nine, who wanted to go to church to be confirmed. When told that it was not a confirmation but a consecration, the small boy said that he didn't care which it was so long as he was done.

If bodily movements are such fundamental and important factors in promoting the growth of a child's mind and body, does it not follow that his early education should mainly be concerned with the right exercise of those movements? And since his interests lie in the direction of activity, have we not here an additional reason for using it as our main educational medium? To use it wisely it is necessary to know the relative value of the various kinds of movement. It has already been shown that all bodily movements are not of equal significance. Acts which are purely reflex or instinctive require no guiding intelligence. A child may sneeze all day without gaining a single jot of intelligence thereby. As for one of those numerous acts which are partly instinctive and partly acquired, the amount of efficiency actually gained by the child is a measure of its educational value. Walking is a case in point. William James is inclined to regard it as a purely instinctive act learnt before the nerve-centres have had time to ripen—before the instinct is fully mature. But whether the instinct is intrinsically imperfect or whether it is merely immature, the fact remains that the art of walking is actually acquired by the child by a large amount of personal effort, by groping his way to success along the line of trial and error; and this gain in muscular control is a gain in mental control as well. It is not congenital efficiency but acquired efficiency that counts.

It has been shown that in the acquirement of an

automatic act attention has gradually been eliminated. By constant repetition an act once voluntary has become automatic, and by the time this has happened its educative value has entirely evaporated. In the practice of acts that are completely automatic no intellectual progress is made—the pupil is simply marking time. It is in the passage from the voluntary stage to the automatic stage, it is in the harnessing of random motor responses and rendering them adapted to serve the needs of the organism that mental growth is stimulated. It is not contended that automatic acts are not useful. They are extremely useful. They economise vital force. They conserve the results of past efforts. They secure easy and rapid adaptation to sudden changes in the environment. They set the attention free to concern itself with other important issues. In planing a piece of wood a boy can think out the next step in the construction of the model. In knitting the sock the girl can think out her scheme for negotiating the heel. The accomplished dancer has no need to attend to his step. He can quite easily carry on an animated conversation with his partner.

Although we can *attend* to only one thing at a time it is possible to *do* several things. A man may walk, and smoke, and wind his watch, and make a limerick all at the same time. This is only possible because three out of the four acts are automatic, are under the control of the lower nerve-centres. Our daily activities are an inextricable mixture of acts that are under attentive control, acts that are automatic, and acts that are partly the one and partly the other. All three kinds are useful, the second kind is indispensable ; but it is only the first and the last that are educative.

It will be noted that among the things that a man can do and an animal cannot, two stand pre-eminent—he can speak and he can use his hands. It is impossible to believe that his superiority over the beasts is unconnected with these two kinds of activity. Neither kind is instinctive. Each has to be acquired by persistent effort on the part of the individual. A baby babbles in almost precisely the same way, whatever nationality he belongs to. A French baby has no congenital predisposition to produce nasal sounds, nor a German baby to produce gutturals. Each has to learn the language for himself, to build up the delicate muscular co-ordinations for himself, by pure imitation of his elders. And as with vocal co-ordinations so with manual co-ordinations. A child inherits few if any fixed modes of using his hands. All the various kinds of manual dexterity, from driving a nail to playing the piano, have to be learnt "de novo" by every child born into the world. Here then, if anywhere, in vocal and manual activities, do we find a fruitful field for the promotion of mental growth. The multitudinous co-ordinations of which the fine lingual and manual muscles are capable, render the vista of improvement indefinitely wide and extensive. The possibilities are practically inexhaustible. Never does one come to the end of the tether in acquiring skill in speech and handcraft. The man who is fluent in many languages is inarticulate in many more. The wonderful hand of Velasquez would falter on the harp, and Rubinstein would bungle at a picture. As subjects of instruction speech and handwork cannot be surpassed. But there are cogent reasons for regarding the hand as in many respects a more important instrument for mental development

than the tongue. Speech comes comparatively late, and takes no part in forming the earliest impressions on the child's mind. But his hand has been active from the day of his birth. It is probably the first sense organ that is brought into use, for during the first few weeks of his life neither his eyes nor his ears are of any service to him. It is in touching and grasping things that the first vague awareness of a systematic world comes into being. It is in the manipulation of objects that his ideas are first formed and moulded, and he gains a notion of the distinction between himself and the rest of the world. It is indeed probable that a child's first ideas are not ideas of objects but of actions to be performed with respect to objects. Even in later childhood the tendency is to fix upon the dynamic aspect of an object. A boy, as Thorndike has observed, always defines a thing by its use. To him a stone is not an indurated mass of earthy matter but a thing to throw at a bird. A little girl, with this tendency strong upon her, once defined an average as a thing for hens to lay eggs on. A child's thoughts are thoughts of doing ; rarely are they thoughts of being. And in doing things the hand is all-important. The vocal organs are used almost exclusively for expression ; the hand is used for impression as well. It investigates and exploits the environment, and the knowledge it conveys is suffused with a strong sense of reality. The sounds of the voice perish almost in their birth : their life in perceptual consciousness is too brief to be of much import in itself ; but the works of the hand are abiding. They crystallise the thoughts of the race and mark the progress of humanity. Take away from our lives everything that is directly and indirectly the work of

the human hand, and we are immediately reduced to the most primitive conditions of savagery.

Finally, let us consider the order of development in the muscular system. On *a priori* grounds it seems as though the larger and coarser muscles—the muscles we have in common with the brutes, the muscles concerned in locomotion and the swing of limb—should be the first to develop. Compared with the fine and intricate muscles of the hand and throat the large muscles of the trunk and limbs are of remoter heritage; their control is rendered easier by the fact that some at least of the co-ordinations are instinctive; they are more closely connected with those adaptations which are immediately vital. Control of the finer accessory muscles comes later in the history of the race, and, generally speaking, the same order seems to be preserved in the development of the child. In his conquest of the body the bigger muscles are first brought into subjection.

> "You run about, my little maid;
> Your limbs they are alive."

It is true that the hand is used from the first, but there is no delicate adjustment of the fingers, and the movements start from the elbow or the shoulder. When a very small child tries to bring about fine co-ordinations he signally fails. He often *tries* to make very small drawings, and this has been urged as an objection to the theory I am expounding. But a child is such an incorrigible experimentalist that he will try anything. It is not everything that a child delights to do that promotes healthy growth. He likes to wade in the puddles, to eat innumerable sweets, to stay up late, and to swagger about with a cigarette in his mouth. Nor

is it quite certain that the tendency to produce very small drawings is spontaneous and natural. It is generally found that a child who draws a cat as big as a thimble has previously been taught to form letters of that size. The teaching of writing, especially of small writing, before the teaching of drawing is productive of much mischief. That a child should exercise his larger muscles before he is required to exercise the finer ones is a principle which is now almost universally accepted. The small child should deal with big things.

It is, as a rule, the more massive muscles that are brought into use in games, athletics and physical drill. Looked at purely from the point of view of mental development, the most important of these activities is the imitative play of young children. This kind of play is in closest touch with the group of thoughts with which their minds are constantly occupied. The child of five dwells in Wonderland. The commonest sights and sounds have for him "the glory and the freshness of a dream." His wonder and admiration find expression in speech, in drawing, and in imitative play. A little girl finds a dolls' tea-party far more wildly exciting than the real tea-party of which it is an imperfect copy. It is *her* party. It is she who has to do everything. She may pour out imaginary tea and sweeten it with imaginary sugar. Make-believe may invade every province but one—that of the actions involved. These must at least be real. It is through them that she fully and completely realises the delirious joy of giving a tea-party; it is through them that her ideas of this particular social function gain clearness and precision. This is the period of toys. A toy forms a nucleus about which a child's activities cluster.

If it fails to call forth these activities it is a delusion and a snare. It is patent to all who have observed children that their appreciation of a toy has nothing to do with its complexity. A miniature motor car that goes by clockwork may at first excite a burst of admiration, but there is no wearing quality in the joy it gives. A simple wooden cart that he can drag along himself will afford him far more permanent pleasure. The essentials are present in the one and absent in the other. It is not the doll that rolls her eyes and squeaks that is abidingly dear to the heart of the little girl, but the old rag doll, the doll that can be cuddled and coaxed, or violently smacked and put to bed. In fact, the value of a toy depends not upon what it does, but upon what can be done with it. It follows that all automatic mechanism in a toy tends to rob it of its *raison d'etre*. Mechanical toys, which were really invented for the benefit of the rich uncle rather than the gift-receiving nephew, should be ruthlessly abolished. Nor should a child be allowed to buy a toy which he could conveniently make for himself. In this respect the boys of last generation, who made the bulk of their own toys with the indispensable jack-knife, possessed an advantage over the boys of this generation. Simplicity or even crudeness in a plaything is often more of a merit than a defect. It leaves a wider scope for imagination, and a bigger margin for skill on the part of the player.

In these early games, with or without toys, the child is realising his social self, and is setting up rough muscular co-ordinations which are not only useful in themselves, but also form a basis for further and finer development. At this stage skill and strength are of

slight importance. Make-believe and a general rightness of action are the essential desiderata.

After the child has reached the age of seven the character of his play undergoes a change. He for the first time begins to distinguish between play, which is an end in itself and always pleasurable, and work, which is a means to an end—a means that is sometimes distinctly unpleasant. His games are no longer predominantly imitative. They become more or less self-contained, and their social significance disappears. He has reached the stage of athletic sports, which are of two distinct kinds—that in which he plays for himself, and that in which he plays for his side. In the one case his own personal skill or prowess is the sole consideration; in the other subordination to the success of the team is superadded. The latter is unquestionably the more valuable, but whichever of the two kinds is taken up—whether individual or organised sport—it must be confessed that its intellectual import is not great. The muscular co-ordinations are in the main those in which the larger muscles are involved. The activities are often of a kind in which the lower animals excel. No amount of training would enable a boy to run as fast as a horse or to jump as far as an antelope. A sea-gull can catch a small fish thrown into the air with greater skill than a cricketer can catch a ball. It is admitted that every gain in muscular efficiency involves some sort of gain in mental efficiency as well; but that gain may be great or small. The mere acquisition of skill in a simple overt movement, such as hitting a ball with a bat, does not in itself mean much. There is no need for consciousness to rise above the perceptual plane. There is no need for more brains than an animal possesses.

The batsman arrives at his skill purely by practice. He fumbles after the right response. When he misses the ball, he knows not why he misses it—he merely hopes for better luck next time. Compare with him the boy doing a bit of constructive woodwork at the bench. His higher brain-centres are constantly active. If he makes a wrong cut, he knows why it is wrong and knows how to rectify it. He analyses the total circumstances and selects the relevant items. In other words, he reasons. The intellectual concomitants of sport are comparatively meagre; the intellectual concomitants of handwork are rich and varied.

Certain enthusiasts are wont to set up extravagant claims for sport—especially co-operative sport—as a means of moral training. The boy learns to take a licking with good humour; he gets to recognise himself as part and part only of an organised system; he learns to subordinate his own wishes and actions to the general good of the whole; he receives an excellent preparation for citizenship; and so forth. It is not contended that all this is not true; but it is contended that games possess no monopoly in these merits. The whole of a child's activities, whether in the school, the playing field, or the home, have, when looked at from a certain point of view, moral worth and moral promise. Every virtue is best acquired in its own setting. The best way to learn modesty about one's intellectual attainments is to be modest about one's intellectual attainments. The best way to learn to speak the truth about one's relatives is to practise speaking the truth about one's relatives. It is by no means certain that virtues acquired in one department of life will be transferred to another department. A person devoid of all trace of social

snobbery may be tainted through and through with intellectual snobbery. It is well known that many a man is as unscrupulous about paying his tailor as he is scrupulous in paying his gambling debts.

There is, moreover, no need for this bit of special pleading on behalf of athletics. When we say that they conduce enormously to the maintenance of physical health, surely we have said enough. In promoting healthy physical growth they provide a favourable, nay, an indispensable condition for healthy mental growth. The same may be said of physical drill. It is a corrective to the somewhat unhealthy conditions under which collective instruction must necessarily be carried on. Looked at purely from the standpoint of systematic muscle training, it is superior to play, for the exercises may be so framed as to train all the voluntary muscles in any proportion. But boys and girls never get keen on drill as they get keen on games. The mental exhilaration throws the balance enormously in favour of games.

The best kind of motorwork is handwork, and the best kind of handwork is that which makes the child think the most, that in which the higher centres of the brain co-operate most completely. Exercises which soon become automatic are of limited value. No intellectual advantage arises from the repetition of a muscular trick that has once been fully mastered, such as a special stitch in sewing or a specific twist in cane-weaving. I am inclined to think that the educative value of sewing as taught in our schools is by no means great. The custom which was once so common of allowing one girl to read aloud while the other girls are sewing gives us a clue as to the amount of brains

brought into use during the sewing lesson. Manual work that does not require the whole of the attention should never absorb the whole of the lesson. It is true that a child's mind need not be always on the stretch, but a certain amount of stubborn mental effort is desirable in every lesson. Automatic work may act as a mental sedative, but never as a stimulant, never as a tonic. It will be found that the sort of needlework girls do with the hand, while following the adventures of David Copperfield with the mind, is such as could be done with a sewing machine. To do indifferently with the fingers what could be done well with a machine is, perhaps, an exercise in patience, but not much else. The plea of usefulness, which is the main justification of needlework, will not serve here. Learning stitches is good, applying them is good, mending is good, designing garments is good ; but the bare practice of stitches—the working of innumerable " specimens "—is mere waste of time.

When headwork goes with handwork, as in drawing, painting, modelling, cardboard work, woodwork and metalwork, provided always the method of instruction is sound, we get the maximum benefit from motor training. For motor training, strictly interpreted, is, after all, only a part of education. Of the reflex arc, which is the starting point of mental development, the muscular response is only one section out of three. It is true that it is a fundamentally important section, but it is well to remember that there are two other sections—the sensory and the reflective. For none of these three departments can be developed alone. It was the primary error of the past to believe that they could. The ancients thought it possible, and

even desirable, to train the reason apart from all reference to the things of sense. The followers of Locke, regarding sensations as the bricks out of which the mental edifice was built, naturally concluded that education should, at least in the early stages, mainly concern itself with sense-impressions. The sounder doctrine is that the mind develops by the elaboration of impulses—the development of the reflex arc as a whole. A child's experience does not grow by the addition of definite bits of knowledge from without, but by an organising process which takes place within. Chaos is reduced to order. That which was before hazy and indefinite becomes clear and definite. This organising process is brought about by motor activity. The reflex arc is the basis of experience. In the earlier stages of development the first and third sections of the arc—the stimulus and response—are kept close together. In a purely reflex act the middle department is reduced to a minimum. In the brute creation it nearly always remains at the minimum. But it is the grand prerogative of man that this control department—this department of thought, feeling and volition—is capable of assuming such colossal proportions that the other departments seem crowded out of existence. Morality excepted, his capacity for abstract thought is probably his crowning glory. To quote Martin Luther, "We deal in such subtleties and such profundities that God Himself, I wot, must sometimes marvel at us." In advocating a system of education based on self-activity the supremacy of thought is by no means forgotten. Neither the poet nor the philosopher is left out of account. It is not a case of motor activity for the sake of motor activity, but of motor activity for the sake of mental

efficiency. If we have refused to keep our eyes constantly fixed upon the goal, it is because we wish to devote our attention to the way by which the goal is reached. In emphasising the genesis of thought, in showing that thought normally comes into being under the pressure of necessity—the necessity for action—we point out the king's highway of mental progress. The poet is not robbed of his aspirations: he is given stronger wings on which to soar. He will be all the better poet for being a man first and a poet after. For to turn out men—ordinary men of sane intellect and sound morals—is the aim of this, as of every other, system of education. Of course, there is genius to be considered. But then genius is no concern of the educator's, for genius can take care of itself. The best thing the educator can do in this case is to stand out of the way.

II.

SCIENTIFIC DATA.

We can no longer disregard the claims of handwork as an educational medium. We are forced to recognise these claims by the conclusions showered upon us by workers on various lines of research. The verdict of the physiologist is clear and authoritative. Our knowledge of the brain and its functions, though still very imperfect, is far in advance of what it was fifty years ago. The broad outlines at least are known. Early in the nineteenth century it was believed by many that the phrenologist might be right. Now it is known that he must be wrong. The phrenologist maps out the surface of the skull into small plots which he labels with long names. If a man has a bump in the middle of his forehead he is possessed of a mysterious faculty called Individuality. If a bump is found a little higher up he has the equally mysterious faculty of Eventuality. These "organs," as they are called, are somewhat numerous, and, as the accommodation of the cranium is limited, there is serious overcrowding in certain parts—round the eye, for instance. The phrenologist assumes that whenever there is a bulge on the skull (unless a lack of symmetry suggests domestic trouble) there is a corresponding bulge on the brain. This assumption is quite unwarranted, for the skull does not always follow the contour of the brain. Nor does a big head necessarily mean a big brain. There is such a thing as being thick-skulled. Moreover, this

preposterous doctrine of faculties is in violent conflict with the most elementary principles of Psychology. The old faculty-psychologist, even in his wildest moments, never split up the soul into departments so numerous, so independent, and so redundant. They are neither simple nor ultimate, and their functions constantly overlap. But apart from its psychological absurdity the phrenologist's theory is finally and irrevocably exploded by the discovery of the true localization of function in the brain. Broadly speaking, we know now how the brain works, to what degree it specialises, and where the special bits of work are carried on. I do not mean to say that there is no leaven of truth in phrenology. There probably is. I believe it possible to tell a man's character from the shape of his head; but I also believe it possible to tell his character from the shape of his nose, or his thumb, or his big toe. And it is possible to argue that the brain has as much to do with it in one case as the other, and no more.* The brain is primarily an instrument for moving the body. It moves it for the purpose of keeping it out of danger—danger arising from such sources as starvation, disease and physical violence. To carry on this work the brain has two sets of servants, the senses and the muscles. The senses are the scouts that give the alarm, and the muscles make the appropriate change in the position of the body. The messages pass along the nerves, and the current always goes the same way—from the senses to the muscles *via* the lower centres and the brain. In the year 1861, Broca, a French

* Dr. Bernard Hollander makes a spirited defence of Phrenology in his book, "The Mental Functions of the Brain." He contends that Gall forestalled Broca.

physiologist, made a very valuable discovery. He found that when a person suffers from motor aphasia, when, that is, he has lost the power of articulate and intelligible speech, there is always one particular part of the brain that has suffered injury—the lowest frontal gyrus. The injury appears on the left hemisphere in the case of right-handed people and on the right hemisphere in the case of left-handed people. He thought he had discovered the sole and entire seat of speech; what he had actually discovered was the speech motor area—that part of the cortex from which pass out all the incitations of the muscles of speech. This was the beginning of a long series of researches, discoveries and acrimonious discussions. The researches are by no means complete, and the storm of discussion still rages; but there are certain facts which have been placed beyond the pale of dispute. One of these well-established facts is that specialised areas in the cortex are of two distinct kinds, those where the nerve-currents run in and those where the nerve-currents run out; those that receive messages from the sense organs and those that send out messages to the muscles. The former are called sensory centres and the latter motor centres. The motor region is to be found on either side of the fissure of Rolando. Of the sensory areas it is generally agreed that the visual is situated at the back of the head and the auditory near the temples. The existence of these centres was established by three distinct kinds of evidence. Let us for the sake of simplicity confine our attention to the motor area controlling the right arm. When this limb becomes paralysed, we may infer the presence of a tumour or hæmorrhage on a specific part of the left hemisphere—

an inference which is found to be justified whenever direct observation is possible, as at a post-mortem examination. This is the pathological evidence. In experiments on animals of the higher type, such as monkeys or dogs, it is found that irritation of the particular part of the cortex already referred to brings about well-defined movements in the right arm or the right foreleg, as the case may be, and that ablation of the cortical area produces paralysis of the limb. This is the vivisectional evidence. Finally, in the dissecting-room neural connections can be traced from the special area to the special limb *via* the motor tracts in the spinal cord. This is the anatomical evidence. The same three kinds of evidence prove the existence of the sensory areas. In recent books on the brain it has been customary to insert diagrams with the various cortical areas definitely marked out and labelled. This is somewhat misleading. The most we can say is that the various cerebral activities tend to cluster round certain fixed spots, and that this localization is more marked in the higher animals than in the lower. One is tempted, therefore, to think of the brain as consisting of cells of two distinct kinds—sensory and motor—with fibres connecting certain sensory cells with certain motor cells, and other fibres connecting sensory cells with one another, and to believe that when the stream of innervation passes along the former fibres we are acting without thinking, and when it passes along the latter fibres we are thinking without acting. Although a microscopic examination of the brain does not entirely bear out this simple theory, it may be taken as a rough and schematic representation of what actually takes place. The

cells found in the brain are very numerous. Meynert estimates that there are 1,200 millions in the cortex alone. These cells are given at birth and there is no evidence that they increase in number. They cannot multiply by fission after the manner of the ordinary organic cell: they can only develop. They develop by sending out fibres which ramify into fine tendrils, and these coming into contact with similar ramifications from other cells set up lines of communication between cell and cell. If this theory is sound, a man cannot by cultivation get more brains, he can only get better brains. It is consoling to know that even in the most highly educated there are large masses of cells wholly undeveloped. They are the unemployed of the cerebral community.

These considerations, vague and indefinite as some of them are, press upon us the importance of the motor factor in the growth of the brain. Progress lies in the line of cell development, and cells develop in order to establish connections between various parts of the brain. The earliest, the most rudimentary, and the most stable connections are those between sensory cells and motor cells, whether those connections are mediate or immediate. Cerebral excitement naturally sweeps from sensory areas to motor areas, so that in opening up new brain-paths the route from sensory to motor appears to offer the least resistance. As the brain becomes more highly organised the route becomes more complex. The current frequently passes from one sensory area to other sensory areas before it arrives at the motor region. In some cases it seems never to reach the motor region at all. But this is an illusion. Closer scrutiny of what takes place in the mind will

reveal the fact that motor factors enter into the most abstract train of thought, and these motor factors must have some physical basis. It is easy to see why a young child lives so fully the life of sense and movement. His sensory and motor cells are being stimulated into activity. To check this healthy tendency in the interests of the higher processes of thought is to take away the ladder by which these higher processes are ultimately reached.

Equally significant is the bearing of the modern theory of evolution on the dynamic aspect of education. It is almost universally recognised that the child must, in a broad and general sense, recapitulate the important experiences of the race. He must go through in brief what the race went through *in extenso*. The general course of development is the same in both cases. Mankind won its way from savagery to civilisation by constant struggle and strife. Primitive man did no fancy thinking; he had enough to do to keep himself alive, and to keep himself alive his muscles were indispensable. What thinking he did he was forced to do. A certain amount of intellectual subtlety was necessary in order to dodge his numerous enemies, both animate and inanimate. The best thinker was the best dodger. The thinking was a device for the attainment of some practical end—the acquisition of food or clothing, the construction of weapons, of utensils, or of the means of shelter. It was only during comparatively recent times that it became possible for man to lead a contemplative life. Education is an attempt to telescope the long path trodden by the race into the short period of a boy's school life. This can only be done by the omission of non-essentials.

But motor activity cannot be omitted, for it is the most essential element of all.

When we come to consider the strictly psychological aspect of the question we find a wealth of evidence awaiting us. In the previous chapter I tried to show how the mental powers came into being as a function of movement. Can we by introspection verify the conclusions arrived at there? If muscular activity is such an important factor in building up the mental fabric, surely we ought to find some evidence of it when we look into our own minds. As a matter of fact, we do. All students of psychology know that the five senses popularly recognised do not exhaust the list. Not only are the temperature and static senses omitted, but the most important sense of all—the motor sense—is left out. What do I mean by the motor sense? Let me answer this question by asking another. If I close my eyes and then shift the position of my arm, how do I know that my arm actually has moved, the extent and nature of the movement, and the position the arm finally occupies? It can only be by sensations of some sort. Is it by the sense of touch? No, for this sense is confined to the skin, and contact with clothing and other objects is no essential part of the total experience. If the arm is bare and the movement unimpeded, I know what has happened just the same. This knowledge can only be due to the general "feel" of the arm—to sensory currents streaming into the brain from the muscles, tendons, skin and joints. The cartilaginous surfaces of the joints are well supplied with nerves, as rheumatic patients will readily testify, and experiments with local anæsthetics have shown how extremely important these nerves are in mediating

a knowledge of position and movement. The whole sensory apparatus involved in movement has been called the muscular sense (which is manifestly inadequate), and the kinæsthetic sense (which is Greek) and the motor sense (which I adopt as being simple and familiar). It has no special organ : its nerve terminations are to be found in nearly all parts of the body. Neither is it given, in the majority of the diagrams published, a special area in the cortex. This omission is due to the fact that the sensory cells concerned with certain muscles are mixed up with the motor cells concerned with the same muscles. The two areas overlap, even if they do not completely coincide. In fact, the motor zone of the brain is at the same time a motor region and a sensory region.

It was at one time believed that we had what Bain called " feelings of innervation," whenever we made a movement. It was thought that some sort of sensation accompanied the motor discharge—that we could feel energy going forth when we made a muscular effort. The majority of modern psychologists have abandoned this belief. A careful analysis of this feeling of effort resolves it into the motor sensations referred to above —sensations due, like all other sensations, to incoming currents, not to outgoing currents.

I have already referred to the motor sense as the most important of all the senses. This statement I will now proceed to make good. There are grounds for believing the motor sense to be the original, the basal sense, from which all the others have been developed. This claim has sometimes been made for the sense of touch. But touch can most profitably be regarded as a part of the whole motor sensibility. The

amount of knowledge mediated by touch pure and simple is insignificant in the extreme. A blind man by feeling a familiar object is able to identify it. We glibly say that he identifies it by the sense of touch. He does nothing of the kind : he identifies it by the sense of movement. Divest the experience of all movement and all muscular pressure, and what is left ? Sufficient, perhaps, to indicate the smoothness or roughness of the surface, but certainly nothing more. It is not without significance that the tactual area in the cortex coincides with the corresponding motor area. In brain localisation they are indistinguishable. It is best, therefore, to regard touch as a subsidiary branch of the motor sense.

Since voluntary movement is a characteristic of all animal life, every animal, however low down in the scale, possesses a motor sense. It is a necessary condition of educability. Even if no special sense organs are perceptible, sensibility to impact with other substances and to change in bodily position must at least be present. The motor sense is the primordial sense.

Activity in the motor sense accompanies activity in all the other senses. A parallel can be found in the fingers. The most important finger is the thumb. When a bit of business has to be done by the hand, two fingers are sufficient to form a quorum, but one of them must be the thumb. It is brought into action with all the others. In the same way the motor sense co-operates with all the other senses. They cannot act without it : it is the inevitable and indispensable partner. One cannot look at an object without a large number of muscles being brought into play. To say nothing of the necessity for turning the head in the right direction,

the small muscles surrounding the eyeballs must so regulate their convergence as to bring the axes of vision to meet at the object; and the still more delicate muscles connected with the crystalline lens must so modify its convexity that the image falls exactly on the retina. The visual apparatus has, in fact, to be put through the same kind of focussing process as a photographic camera, allowance being made for the fact that in the camera the convexity of the lens is fixed and the position of the plate variable, while in the eye the position of the retina is fixed and the convexity of the lens variable. These muscular experiences of convergence and accommodation, even though they appear to be entirely subconscious, form an essential part of the whole process of perception. They are so fused with the purely visual impressions as to be indistinguishable from them; but their presence is none the less indispensable. The senses present data; the mind interprets the data; the interpretation is an object in space. Motor sensations always form part of the data interpreted; they are vehicles of knowledge concerning the object. They are of special service in telling its distance from the eye, its size, and its solidity as opposed to its flatness. Vision pure and simple presents a mere patch of colour: the motor concomitants help to turn this patch of colour into a three-dimensional object occupying a definite position in space.

In much the same sort of way the motor sense collaborates with all the other senses.

But apart from these motor sensations which get swallowed up in percepts, the sense organs actually stop working unless their position is changed. If you will take the trouble to sit stone still with your gaze

steadily fixed on a spot on the opposite wall you will find that at the end of about ten minutes a black veil seems to fall and blot out the whole field of vision. You become temporarily blind, but normal vision can readily be restored by a slight shifting of the eyeballs. Rest your hand lightly upon the table so as just to feel the surface. After a short while you cease to feel anything there. Move your hands ever so little and tactual sensation is immediately restored. Without movement, in fact, sensation and perception become impossible.

My third reason for claiming precedence for the motor sense is that it gives us the most vivid and convincing feeling of reality. It is through the actual manipulation of objects that the notion of a systematic external world as distinct from his own mental images gradually emerges in the mind of the young child. We ourselves always put doubtful experiences to the authoritative test of touch. The doubting apostle is the type of all doubters. Macbeth apostrophises the spectral dagger :

> "Come let me clutch thee :
> I have thee not, and yet I see thee still.
> Art thou not, fatal vision, sensible
> To feeling as to sight? or art thou but
> A dagger of the mind ? "

and so forth. The conclusion he arrives at is, "There's no such thing." In deciding the reality of a percept the motor sense is the highest court of appeal. It decisively confirms or discredits the evidence of the other senses ; the experience is stamped as real or hallucinatory. Its verdict is accepted as final.

My last ground for attaching supreme importance to the motor sense is its intimate connection with the process of attention. If I were to say that we attend with our muscles I should seem to be uttering an

absurdity. Yet that is what Bain, Ribot, Lange and other psychologists virtually assert. The focussing mechanism of the eye is also the focussing mechanism of visual attention. Looked at from the outside attention is muscular adjustment; looked at from the inside it is mental activity. The muscular activity, according to this school, is neither the cause nor the effect of attention: it *is* attention looked at from one of two possible points of view. The truth of the matter seems to be that muscular contractions always accompany the attentive process, helping to produce and to maintain it; but to say that they form an essential part thereof is probably to mistake the scaffolding for the temple. The fact, however, remains that there is a very close connection between at-tention and muscular tension. In acts of perception this is obvious. Not only is the sense organ so adjusted as best to receive the stimuli, but all movements tending seriously to interfere with this reception are inhibited. At the most exciting moments in a football match the spectators tend to hold their breath. This principle of motor impulsion and inhibition holds equally good when we attend to ideas, except that the innervation of the muscles is generally much slighter.

A marked characteristic of the motor elements of consciousness is their tendency to float further and further away from the focus and ultimately to enter the region of the subconscious. This is connected with the fact that all acts tend by repetition to become automatic, and in becoming automatic need a smaller and smaller amount of attentive control.

When we come to consider the ideational plane of consciousness we find the *rôle* played by motor elements

just as important as on the perceptual plane. Mental images are the dim ghosts of departed percepts and are free from the perceptual limitations of time and space. They flit hither and thither at the bidding of the wizard mind, serving his intellectual needs far better than percepts. Without them, indeed, a wide and rapid range of thought is quite impossible. But, however widely they differ from percepts, they resemble them in being built up of elements ultimately derived from the separate senses. Images may be mainly visual, or mainly auditory, or mainly motor, but are never purely so. They are mixed like the percept itself, and like the percept have always a motor constituent. I think of a pair of scissors ; a visual image immediately emerges in my mind. But this is not all. In addition to the motor elements inextricably mixed up with the image there appear memories of movements experienced in using the instrument, and it is this dynamic constituent of the image that serves as the most valuable medium of thought. Try to think of the word "Mabel" with the mouth open, and the difficulty experienced in getting a clear image brings to light the motor factor in what seems to be purely auditory memory. In referring to sensory and motor elements, it must be borne in mind that they are merely the vehicles of thought : they are not thought itself. The image is laden with meaning, but the meaning, is a distinct content which may, perhaps, be equally well conveyed by several other images. The most opulent mental imagery may be almost empty of meaning, while the scantiest of images may be heavily charged with thought. As the image gets used in various trains of thought, there is a tendency for the vehicle to get less

and the meaning it carries to get bigger. In purposeful thinking there is an economy of sensory media. As we grow older our mental imagery grows scantier and more symbolic. Galton has given us evidence which shows that distinguished men of science nearly always think in words. Their images are purely verbal, and in the general decay of the verbal image along the line of economy the visual feature tends to disappear, but the auditory and motor features seem to form an irreducible residuum.

In the process of "learning by heart" there is a manifest tendency for all images to pass into the motor type. We must distinguish between memorising a poem so as to be able to reproduce it by thinking closely of the sense, and learning it by heart so as to be able to repeat it with such ease and fluency that there is no strain at all upon the attention. Is this latter kind of memory visual or auditory? The slightest reflection will show that the minimum memory necessary to achieve this is a memory of a fixed sequence of movements of the vocal organs. If these movements are controlled by images at all, those images are of the motor type. Other types of images are present, no doubt, but motor images form the essential factor, or rather motor sensations; for the "feel" of each movement, as it takes place, acts as a cue to the next movement. The process becomes an acquired automatism. To learn by heart is really to learn by muscle. The same is true of spelling. Spelling may at first be a matter of the eye or the ear; but ultimately it becomes a matter of muscle. Spelling in the adult is automatic. One test of automatism is the disorganisation caused by conscious attention. I attend to my mode of walking

and immediately become awkward and inclined to stumble. The speller who hesitates is lost.

Most psychologists are agreed that conception represents the highest simple function of which the mind is capable. We may see the boy John (perception), or think of the boy John (ideation), or think of boy as a class (conception). In the last case we leave the realm of particulars and reach universals. Surely here if anywhere we find ourselves among mental products which are free from motor implications. But it is not so. It is true that the logician regards a concept as a bundle of definite qualities which serve to distinguish a class of things. But this fixed bundle of qualities is a psychological myth. Conception in its ordinary mode of operation is merely a mental attitude. It is that attitude of the mind which enables it to regard different things as though they were the same, knowing at the same time that they are individually different. Baldwin contends that its nature is essentially motor. It is the process in which the mind reacts in the same way to different things or different objects of thought. It will readily be conceded that conceptual thought as an exclusive characteristic of the human mind is something more than this ; that it implies the apprehension of a clear distinction between the class and the individuals composing the class, and that language is necessary in order to maintain and develop it ; but at the same time conception may profitably be regarded as a special mode in which the mind seems to react upon its own contents. Let us suppose that I wish to drive a nail into a plank. I may use a hammer, a poker, a crowbar or a stone. For the purpose in hand all these instruments are the same : they are nail-driving instruments.

Thinking is somewhat analogous. All thought has a purpose: it moves towards an end, theoretical or practical. To achieve this end the mind uses its percepts and ideas as instruments. It uses different instruments indifferently, conscious of the fact that one would do just as well as another provided the differences between them were irrelevant to the purpose in hand. This is conception.

It will thus be seen that motor experiences and motor memories pervade the whole of our intellectual life. Like the air we breathe, they escape our notice by their very universality. Their value as intellectual factors is nowhere more clearly to be seen than in the story of Helen Keller, that marvellous American girl who can neither see nor hear, has not reached thirty years of age, and yet has arrived at a degree of intellectual culture which some of the most learned of my readers may justly envy. Born in the year 1880, she was by a serious illness, which befell her when she was but eighteen months old, totally deprived of both sight and hearing. When she was ten years old she very rapidly learnt to speak clearly and intelligibly after the manner of the oral speech of deaf-mutes, although she was under the serious disadvantage of being unable to see the lip and throat movements of her teacher. Oliver Wendell Holmes saw her at this period and describes her as a dear little girl full of life and happiness. He received a charming letter from her dated March 1st, 1890, and beginning :—

"Dear Kind Poet,—I have thought of you many times since that bright Sunday when I bade you good-bye, and I am going to write you a letter because I love you. I am sorry that you have no little children

to play with sometimes, but I think you are very happy with your books and your many, many friends. On Washington's birthday a great many people came here to see the little blind children, and I read for them from your poems, and showed them some beautiful shells which came from a little island near Palos." She ends up thus : " If my little sister comes to Boston next June, will you let me bring her to see you ? Now I must tell my gentle poet good-bye, for I have a letter to write home before I go to bed. From your loving little friend,

HELEN A. KELLER."

The catalogue of her present accomplishments is astounding. She reads raised print fluently, reads and writes the Braille point for the blind, has a creditable knowledge of Latin, Greek, French and German, writes the ordinary script hand, uses a type-writer skilfully, has an extensive knowledge of literature, keeps up a voluminous correspondence, and writes stories which give evidence of originality and literary taste. How many of us, with all our faculties intact, can say as much? What does all this mean ? It means that the raw material which was elaborated into this finished product, Helen Keller's mind, was derived from two sources only—from touch and from movement. It seems to indicate that in arriving at mere intelligence it matters not what avenues of sense are blocked up so long as the tactile and motor channels are left open.

So far we have dealt with but one side of the human mind—the cognitive side. But there are other sides—other modes of being conscious. We can not only think ; we can also feel and will. I have been at some pains to show that thinking is intimately connected with

doing ; it were comparatively easy to show that the same is true of feeling and willing. The nature of that curious plexus of pleasure and pain which we call an emotion is betrayed by its very name. We talk about a person being moved to anger, to pity or to fear. Outward bodily changes become manifest. If a man with flashing eyes, grinding teeth, flushed face, and clenched fist approaches me menacingly, I infer that he is angry. I am inclined to regard these signs as an expression of his anger, an effect produced by a mental disturbance. This is a mistake. The various muscular contractions, the disturbances in circulation and respiration, the changes in the glands and so forth, are the expression of an idea (the idea probably that I deserve a thrashing), the real emotion, the anger, being the feeling of these physiological changes. At least, that is what William James says, and he is probably right. An emotion is the mental counterpart of motion among the muscles, voluntary and involuntary, or rather of the bodily processes resulting therefrom. We can control our thoughts and we can control our movements ; but have we any direct control over our feelings ? I think not. The content of consciousness being given, I cannot by choosing render it pleasurable or painful. If I feel a red-hot poker on my hand I cannot elect that the feeling should be a pleasurable feeling. Once having got the sensation, I am helpless. So with an emotion, which is a complex of sensations caused by some exciting percept or idea. When the sensations enter consciousness they bring their own feeling tone with them. We can neither shut it out nor alter it. Suppose I awake in the night and hear burglars at work downstairs. If I let my mind dwell upon the

possibilities of personal violence and assume the crouching attitude of fear, then I cannot help feeling frightened. There are only two ways of curing my fright, both of them indirect. The first is to think of something else—rather a difficult task. The second is to assume the bodily attitude characteristic of courage. This is Henry the Fifth's advice to his soldiers at Harfleur :—

> " Imitate the action of the tiger ;
> Stiffen the sinews, summon up the blood,
> Disguise fair Nature with hard-favoured rage ;
> Then lend the eye a terrible aspect.
> . . . . . .
> Now set the teeth and stretch the nostril wide,
> Hold hard the breath,"

and so forth. If I adopt this advice I shall probably get rid of my fear. To get rid of the burglars is another matter.

It will be noticed that of the physical concomitants of an emotion only half is within our control—the half that is connected with the voluntary muscles. But once this half is suppressed, the other half will quickly fade away.

It is my duty to love my neighbour, nay, even my enemy. But how can love be a duty ? How is it possible by an act of will to acquire a liking for somebody whom I instinctively dislike ? There is at least one thing that I can do. I can act towards him as though I did love him. And strange to say the kindly feeling will follow. For it has often been observed that we like those whom we have benefited better than we like those who have benefited us. A warm and loving heart is not entirely the gift of Nature : it is at least in part the reward of " many nameless unremembered acts of kindness and of love." But there is more that I

can do, and that more depends upon the fact that I can exercise control over my thoughts. Overt acts are in themselves insufficient. St. Paul has oft been quoted in support of this position : " Though I bestow all my goods to feed the poor, and though I give my body to be burned, and have not charity, it profiteth me nothing." I must get the right feeling ; and to get the right feeling it is sufficient to get the right mental attitude—to acquire the habit of fastening upon the lovable traits in my fellow-man, and so be to his virtues very kind and to his faults a little blind.

This brings us to volition. What is that mysterious power which we call the will ? There are some who deny its very existence. They contend that it is an illusion, as the ego itself is an illusion. There is, they assert, nothing but the stream of consciousness. An orderly array of ideas come and go according to certain fixed laws. And there is no soul to witness the process. The mind does not know the ideas : the ideas simply know themselves. The ideas are not *in* the mind : they *are* the mind. To most of us this doctrine is incredible. The man who hunts for his ego and cannot find it is engaged on the same quest as the old gentleman who went searching for his spectacles with his spectacles on his nose the whole while. There are others who believe in the soul but deny that it has any authority or dominion. It witnesses the panorama of consciousness, but has no power to interfere with its working. It stands aloof as an impotent spectator. This doctrine is held by those who emphasise the physiological aspect of the question, who believe in the inexorableness of the law of cause and effect, and who deny that consciousness can have any effect upon matter,

that the mind can ever be the cause of changes in the brain. There are others among us who repudiate the intellectual arrogance which, having found certain laws in operation in the physical realm, uses them as a basis for dogmatising as to what is possible and what impossible in the realm of consciousness. We prefer accepting the plain verdict of consciousness. There is a soul, a self, an ego—call it what you will—and this soul is no mere passive looker on. It enters into the *mêlée* of ideas and is an important factor in deciding the issue. Within certain obvious limits it has the power of choosing its own experience. It can attend to certain objects of thought and withdraw its attention from others. This power we call will.

The first point to note is that my will can only act through my muscles. The only immediate outward effect it can possibly produce is movement in some part or parts of my own body. Indirectly it can do more; but directly it can do this and this only. To produce this movement no special force or power is needed, for ideas themselves (including, of course, percepts) are in their very nature impulsive: they belong to a current which has not reached its terminus: they tend to work themselves out in bodily activity. In the case of reflex and instinctive acts this tendency is obvious: certain fixed arrangements in the nervous system decide the matter. But what is the nature of the mechanism by which voluntary acts are carried out? Introspection can find nothing intervening between the thought of a movement and the movement itself. I think of taking my watch out of my pocket, and forthwith the thing is done. The mere idea of the movement is in itself sufficient, provided there is no

antagonistic idea present in the mind at the same time. But the idea of the movement before it actually takes place implies images left by previous movements. How did I originally get these images? Obviously through movements of a random or reflex character. Spontaneous activities are an essential preliminary to the voluntary life. A stock of motor images is necessary before the will can begin to operate at all. But what happens when an antagonistic idea is present, when I wish to do two incompatible things? Do the two ideas fight it out among themselves, or does the ego step in, and put its veto on the one and give its sanction to the other? As it is not always the stronger impulse that wins there is some reason for thinking that the ego does interfere. However that may be, the fact remains that one of the movements will be inhibited. This process of inhibition—of checking movement—is of the highest import in the development of intellect and character. For the will is trained not so much by doing things as by not doing them. To refrain from action often requires palpable effort. A tendency to cough at a public meeting cannot always be checked without a strong effort of will. Where there is less organic stability in the physical basis of the impulse the effort is not so manifest. But we are constantly inhibiting, we are constantly putting on the brakes, we are constantly diverting the stream of innervation which runs from every idea that enters the mind. Sometimes none of the stream seems to escape, and the energy which in a more primitive type of mind would be expended in bodily movement becomes dissipated in thought. All progress in self-control is progress along the line of inhibition. A very young child acts entirely

upon impulse. But in course of time he learns to check those movements that lead to painful issues. He begins to look before he leaps, to think before he acts. But inhibition is of gradual growth. It presupposes experiences gained by impulsion. The very reason for suppressing a movement is that its consequences are known, and known to be undesirable. Complete inhibition in the experienced adult is favourable to contemplation ; in the inexperienced child it is favourable to slumber.

Looked at purely from the psychological side, will is hardly distinguishable from attention. Within the realm of consciousness the only control the mind can have is attentive control. It can think of some things and refuse to think of others. In ordinary cases all that the mind does in order to make a movement real is to attend to the idea of that movement. Tenacity of purpose means stubborn and exclusive attention to certain salient aspects of a situation or certain ends to be achieved. And as in the control of movements inhibition is an essential factor, so in the control of thought non-attention is an essential factor. All effectiveness in thinking depends upon concentration, and concentration depends upon inattention. What seems an effort to attend to one particular thing is really an effort not to attend to anything else. To intensify the stream of thought one must narrow the current, at least to the extent caused by the withdrawal of energy from all that is irrelevant.*

But I have already dealt with attention and shown how closely it is connected with innervation of the

* See, however, Professor Adams's "Exposition and Illustration in Teaching," p. 156.

muscles. There I showed that the muscles enabled us to attend ; here I show that attention enables us to move the muscles.

The upshot of our inquiry is that we cannot look at the human mind from any point of view without having the fact forced upon us that motor activity is of vital and fundamental importance ; there is no nook or cranny of the mental structure where motor elements are not found to enter ; there is no mental process or mental product that does not receive some support from muscular experiences ; there is no emotion or volition that is not mediated by movement ; there is no intellectual or moral progress that is not in some way connected with either the promotion or the inhibition of bodily activity.

III.

THE NEGLECTED MIDDLE.

If I were asked to indicate the weakest spot in the curriculum of the Elementary School, I should immediately point out the absence of handwork in the lower classes of the senior department. From the time the child enters the school at the age of three or five, till the time when he leaves at the age of fourteen, his educational career should be unbroken. The break that seems to occur when the child passes from the infants' to the senior department is a mere accident of school organisation, and should involve no interruption in the course of training which he is undergoing.

Considering this course as a whole, we find kindergarten occupations at the lower end, manual or domestic training at the upper end, and nothing in the middle. The boy uses his hands freely from the ages of three to seven, he uses his hands systematically from the ages of eleven to fourteen; but from the ages of seven to eleven he does not, comparatively speaking, use them at all. I have stated the case very broadly and very crudely, for I have made no reference to such obvious forms of handwork as drawing, writing and needlework, which are more or less common to the whole course; and I have assumed that the system in vogue in London is, with slight modifications, the system in vogue all over England. I have some grounds for making this assumption. Two years ago I sent round circulars to every important Education Authority

in England and Wales with a view to discovering what was being done for the junior classes in other parts of the country. The replies were vague, and on the whole disappointing. In no instance does an Education Authority seem adequately to have grappled with the problem of providing these young boys and girls with proper facilities for constructive handwork. I may, therefore, safely assert that as a general rule we have handwork at the top of the school, handwork at the bottom, and none in the middle.

This position is palpably absurd; it is illogical to the point of grotesqueness. I can well imagine somebody contending that handwork is good for little boys, but bad for big boys; or good for big boys, but bad for little boys; but I cannot imagine anyone seriously contending that it is good for very little boys and good for very big boys, but bad for middle-sized boys.

I need press the point no further. I can safely assume that every reader of this book believes in the urgent need for reform in the way of bridging over this chasm which extends over four or five of the most important years of a child's life.

We are all agreed upon this point, but when we come to consider the kind of work that we should introduce into these classes we find ourselves like a kingdom divided against itself. There is no lack of opinions, or indeed of strong opinions, but these opinions are often in violent disagreement. When, in fact, we ask practical teachers what is possible or desirable in the way of handwork in the middle of the school we are met with a babel of contradictory replies. To illustrate what I mean I may tell you that I was present some short time ago at a conference of teachers and

inspectors who had met together to discuss the very subject I am now dealing with. The following account of what happened possesses as much accuracy as may reasonably be expected of one who took no notes. Every teacher in turn was asked to express his opinion. The first speaker displayed some very beautiful diagrams illustrative of a course of cardboard modelling which he had invented, and he read to us a list of the manifold advantages which would accrue from taking up his scheme. It was a very long list, and strongly suggestive of an advertisement of a patent medicine which was warranted to cure all the diseases incident to mankind. After he had finished one felt that if what he said was true there was but one rational thing for us to do. We must abolish all our present subjects of instruction, all our present cumbersome educational methods and devices, and adopt this gentleman's system of cardboard modelling. As this one subject entirely filled the bill, the other subjects were obviously superfluous.

But when another speaker proceeded to take a basket from under his chair and to empty on the table a perfect cascade of little gimcracks made of strip-wood, and began to descant upon the far superior advantages of strip-wood work—if taken in his way—we began to waver in our allegiance to paper modelling.

Then another speaker said that all this was going on a wrong track; the material did not matter very much; the object made did not matter very much; what did matter was the tool used. A child should be taught to use one simple tool—such as a knife, a saw, or a plane—master all its possibilities, and then proceed to another instrument, and so on, and when he had

mastered all the common tools his manual education was complete.

This position was immediately attacked by a teacher who contended that handwork based upon the use of tools was quite unworthy of the name. The best kind of manual training was afforded by the unaided exercise of the hand and fingers. The fewer the tools the better the scheme. The best scheme did not involve the use of tools at all.

The next speaker contended that the one material that was of any value at all was wood; paper work, cardboard work, and clay modelling were all pure waste of time, merely trifling with the subject. Genuine *bonâ fide* handwork must deal with wood and with wood only. All the rest were spurious and mischievous imitations. The speaker who followed said he quite agreed with the gentleman who had just spoken. There was only one material that was of any value. But he had mistaken the material. It was not wood; it was clay. That was *the* material *par excellence*. Nothing exercised the tactile and muscular senses so adequately as clay or plasticine. It was cheap, it was easily prepared and distributed, and it readily lent itself to an interesting series of exercises. Clay modelling was the one and only occupation. This was first and the rest nowhere.

But another speaker objected strongly to clay modelling on the score of the difficulty with which it lent itself to exact measurement. Nothing was of any value, he said, which could not be exactly measured; and if it could be exactly measured it did not matter in the least what it was—whether it was paper or cardboard, or wire or iron or wood. If it could be exactly

measured it was good, and if it could not be exactly measured it was bad, and that was an end of the matter.

Another speaker put in a plea for simplicity at all costs. Paper and thin cardboard and paper fasteners were all the materials necessary, and a pair of scissors the only instrument.

The next speaker strongly objected. Scissors, he said, were all very well for little girls and old women, but a boy would require a knife. Whether he worked in paper or in cardboard, a knife and a cutting board were absolutely essential.

There was an American lady present, and she contended that all the previous speakers had gone astray like lost sheep. These systems were all very well in a way, but they needed a pervading and controlling idea. It was essential that the handwork should have a central thought about which all the occupations clustered. For instance, in those schools in America where the manual work was under her superintendence, all the handwork in Grade I. had to do with the home. The home was the pervading idea. The children made a doll's house and furnished it throughout with miniature chairs, tables, bedsteads, carpets, wallpaper, &c. In another Grade the central idea was locomotion, and ships and trains and waggons were constructed, and horses and camels and oxen modelled, as illustrations of various means of locomotion.

When we left that meeting everybody seemed convinced that his own system was right, that all the other systems were wrong, and that compromise was a thing not to be thought of. Those people who, like myself, had an open mind, began to wonder how it was possible to bring order out of all this chaos.

To attempt to do that is part of the work I have set before me in this chapter.

To begin with, to direct our attention to superficial details merely leads to intellectual confusion. We must get down to bed rock; we must get a firm grip of a few guiding principles and work out our system from them.

If you will think carefully of the various systems of manual training adopted in this country and in America, you will find that each is dominated by one of two fundamentally distinct principles, and it is very important that we should get a clear and luminous view of these two principles.

We are fortunate in having them well exemplified in our own schools. I have called attention to the fact that we have handwork at the top of the school and handwork at the bottom, but if you will carefully consider them you will find that they are diametrically opposed in kind.

The woodwork done at the manual training centre is a logically worked out system. The exercises are carefully graduated. They proceed from simple to complex. They are devised with the object of acquiring mastery over the material and mastery over the tools. The acquisition of skill is the aim the teacher has primarily in view. He may have a secondary aim. He may believe, and he probably does believe, that the manual work develops intelligence as well; but he does not think of this in devising or working out a scheme. What he asks himself is this: how can I most rapidly and most effectively give this boy mastery over this branch of handicraft? The standpoint is the standpoint of the adult who wishes to gain the rudiments of a trade. The child, his instinctive ten-

dencies, his interests, his desires are entirely left out of account. It does not matter whether the boy likes the course or not ; it does not matter whether he is interested in it or not ; it does not matter whether the object made is such as he would spontaneously make—as he would make if left entirely to his own resources. What does matter is that his manual dexterity should be trained by an orderly sequence of exercises.

The occupations in the infants' school are of quite a different character. Here there is no ordered system, no careful gradation of exercises, no adherence to one medium of expression. No attempt is made to give the child perfect mastery over any instrument or any material. The primary aim of the teacher is not the acquisition of skill, but the clarifying and vitalising of ideas. It is true that skill is incidentally acquired, but the important thing is that the child should make his ideas clear, vivid, and usable, by indulging his instinctive tendency to express them in a variety of media. The manual work in the infants' school is expressional work. A child is interested in making anything ; he is still more interested in making something which serves some purpose ; he is most interested of all in making something which serves his *own* purpose. Thus the manual work in the infants' school grows naturally out of the child's life in the home and the school. It has no independent basis of its own. Cut adrift from the rest of the mental life of the child it becomes a meaningless jumble of exercises. To-day he sketches a daffodil with coloured crayons, to-morrow he models a rabbit in plasticine, and the following day he makes a little basket of bast. There is no continuity in these exercises. They are not connected with one

another : they are merely connected with the intellectual course set forth for the child. It is not denied that there is an attempt at gradation in the clay modelling, paper folding, &c., but the gradation is subservient to the main idea—the idea that the work is expressive, that it is a practical way of assimilating knowledge.

It will be seen that these two principles are poles asunder. While one aims at giving the child control over matter, the other aims at giving him control over mind ; in the one we have motor training as an end in itself, in the other the motor training is a means to some other end. In the one mechanical skill is aimed at, and the intellectual training becomes incidental ; in the other intellectual training is aimed at, and the mechanical skill is incidental. In the one the intellectual interests of the child are not taken into account ; in the other the intellectual interests of the child form the one determining factor in the selection of the kind of exercise. In the one, accuracy forms the basis by which progress can be gauged ; in the other, accuracy forms a very inadequate criterion of progress. You cannot tell by merely looking at a thing made by a boy how much brains he has put into it.

The future of manual training will result from the conflict between these two broad principles. In England one is at present established in the top part of the school ; the other is established in the infants' department. Some reason now appears for the hiatus in the middle. It has probably been felt in a vague sort of way that these boys are too old for expressional work and too young for technical work. And if, to provide these children with some sort of handwork, the systematic work of the top classes is extended downwards and

the expressional work of the infants' department is extended upwards, there will always come a point where the two systems meet and clash. The middle of the school, in fact, serves as a battle-ground for these two conflicting principles.

In America the expressional idea is gaining ground every day. Under the influence of Dr. Stanley Hall and Dr. Dewey the old idea of technique—of mere mechanical skill—is yielding to the pressure of expressional doctrine. In England the tide of victory is definitely setting in the same direction. The expressional principle is winning all along the line. We see clear evidence of this in the changes that have taken place in our woodwork system. It has already passed through two stages and shows some signs of emerging into a third. In the early stage, as Mr. Raymont has clearly pointed out in his "Principles of Education," the process was everything, the product nothing. The pupil was put through a series of barren exercises in planing, marking, sawing, chiselling, &c., with bits of wood which were afterwards thrown away. Joints of various kinds were made purely for practice. The process was everything, the product nothing. It then passed into a second stage in which the product was regarded as of some importance, although still subservient to the process. The pupil was allowed to make objects which could be put to some use; but the use had reference to the adult, not to the child. They were not objects which a boy would spontaneously make. This is the stage of Sloyd, and is, generally speaking, the stage in which woodwork is found in England at the present time. But there are not lacking signs that it is about to enter upon a third phase, in

which the dominant interests of the boy determine the objects to be made, and the process is regarded as subservient to the product. And when it has reached this stage, it has entirely capitulated to the expressional principle. In the first stage he makes something which is useful to nobody, in the second stage he makes something which is useful to somebody, in the third stage he makes something which is useful to himself. In the first stage he expresses nothing, in the second he expresses something, in the third he expresses himself.

What are we going to do ? Are we going to identify ourselves with one of these two courses ? Are we going to say : We will have nothing to do with the slipshod systems of America or with the frippery of Froebelian occupations ? The soft pedagogy of the period makes no appeal to us ; we will give our boys a good solid English training ; we will bring out all the grit that is in them, and turn them into good well-drilled craftsmen. Or shall we definitely throw in our lot with the new education and fight under the expressional flag ? But is it necessary to do either ? Are the two principles incompatible, like God and Mammon ? Must we hold to the one and despise the other, or can we consistently vow allegiance to both ? As a matter of fact, the latter is the only possible course. That compromise is possible is proved by the fact that compromise is continually taking place. That compromise is desirable is evident when we reflect that we cannot dispense with either of these principles. Purely expressional work is inclined to be slipshod and shapeless, and about the age of eight a boy ceases to be interested in drawing trees that look like men and men that look like scarecrows. Some

training in technique is required as a corrective. The boy (if there really was such a boy) who having badly drawn a map of England laid his hand upon his heart and said, "England, with all thy faults, I love thee still," had at least got so far as to realise that his drawing *had* faults. Nor can we reject the expressional doctrine, for to do so is to stand aloof from the movement of reform which is profoundly changing the whole curriculum of the elementary school—a movement which is due to the shifting of the point of view from the adult to the child. In the olden times it was regarded sufficient if the teacher knew his subject, now we consider it essential that he should know the boy as well. The problem the old-fashioned teacher set himself to solve was this: If I had to learn this subject all over again, how should I proceed? He accordingly drew up a systematic scheme starting with the simplest principles and ending with practical application. Grammar was taught before composition, abstract arithmetic before concrete arithmetic, and the drawing of straight lines and curves before the drawing of objects. The form of the whole scheme was perfectly logical, and the only thing to be said about it was that the boy could not digest it in that form.

The newer education has changed all that. The boy now becomes the determining factor. We now recognise the fact that his mind grows as his body grows—by food and exercise. To nourish his body on peptonised food and deprive him of physical exercise is the surest way to turn him from a man to a mollusc. He must digest his own food and take his own exercise. It is equally imperative that he should assimilate his own experience—that he should be allowed to deal in his own

way with those impressions coming from the outside world which constitute the crude material of thought. These impressions should not be pre-digested for him.

We all believe in this doctrine nowadays, and it is impossible any more to accept unreservedly the old point of view. We see, therefore, that we can discard neither the expressional nor the technical principle. Each has its merits and its defects, and the points on which one is weak are the points on which the other is strong. Is it not, therefore, irresistibly borne in upon us that the right thing to do is to join them together in holy matrimony? Like Jack Sprat and his wife, they will prove to be mutually complementary. A perfect system of manual training would in fact serve as a means of self-expression, and at the same time gradually develop manual dexterity. There is no real incompatibility between the two principles. It is merely with them, as it is often with husband and wife, a question of which shall be master. In my opinion the dominating principle should be the expressional. That a manual training course should be systematic is desirable, but that it should be expressional is essential. And if it is to be expressional it must be correlated with the boy's intellectual pursuits. The principle of correlation has been so abused in some quarters as to bring the term into disrepute. In straining after the letter the spirit has been allowed to escape. There is a passage in "King Lear" in which the mad king says that he is "every inch a king." A certain teacher, in explaining that passage to his boys, got them to tell him that the king was probably about the average height, that is, about seventy inches, and that he claimed to be equal to seventy kings. "Quite right,"

said the teacher, "no wonder they thought he was mad." He called that correlating Shakespeare with arithmetic. It is quite true that the handwork should be correlated with the other subjects of the school curriculum, but we must be sure that the correlation is a real correlation, and also remember that the field afforded by the school work is too narrow for our purpose. For, as far as handwork is concerned, the essence of correlation is expressed in the following maxim: Let the child make what he has recently been thinking about. But surely he has been thinking about other things besides his lessons. A boy spends considerably less than half his waking hours in school, and too often his heart is more in the things he learns outside the school than in the things he learns within the school. To correlate truly is to correlate with life itself—with the school, the playing-field, and the home. This widens the scope of selection so that the number of suitable activities becomes indefinitely large. Looking at correlation from this point of view, we realise that we can dispense with the use of the word altogether. It is simply the expressional idea in disguise. If a boy is engaged in expressional work he is doing what he has been recently thinking about, and if he is doing what he has been recently thinking about, he is doing all that is required by the most exacting advocate of the principle of correlation.

Let me now call your attention to another point of difference between the work done at the top of the school and the work done at the bottom. In the top classes the manual training generally takes the one form of woodwork. In the infants' school the manual occupations are many. Shall we in the middle adopt the one

or the many ? Shall we confine ourselves to clay modelling or to cardboard modelling, or to strip-wood work, or shall we take up several of them ? If we are to remain true to the principles already laid down we have no option : we must retain the many. The larger the number of media by which a child expresses his ideas the more complete is his control over those ideas. A number of occupations gives the individual child a greater chance of finding his particular bent. There is wisdom in the practice of the sportsman who loads his gun with a number of small shot. It increases his chances of hitting the bird. And the old-time doctor prescribed a long list of drugs in the hope—a somewhat futile hope—that if one of them did not reach the disease another of them would. So there should be in the lower classes a reasonable variety of occupations to suit the diverse interests and capacities of the boys.

As there are two types of handwork to be found in our schools, so are there two types of method. The one is the directed method, where the teacher guides the pupil at each step; the other is the heuristic method, where the pupil is allowed to exercise his own initiative. The one is the do-as-I-tell-you method, and the other the find-out-for-yourself method. Of these two methods the first is bad and the second impossible. The directed method is bad because it reduces the child to the position of a machine ; the heuristic method is impossible because the time at our disposal is limited. The best method is the heuristic method supplemented by a minimum of guidance.

It follows that we cannot estimate the value of a course of handwork by merely looking at the results. All depends upon how these results have been obtained.

Good results obtained by the directed method mean bad training, and indifferent results obtained by the heuristic method may mean good training. We do not wish to valuate bits of timber, but the amount of mental development. The temptation to produce beautiful models to show the inspector, or to display at an exhibition, should be strongly and persistently resisted by the teacher. The inspector who understands his work will not expect figs from thorns ; and as for exhibitions, in so far as they encourage insincere work, they should be ruthlessly suppressed.

The last point of difference between the manual work at the top of the school and the manual work at the bottom has reference to the teacher. At the top of the school there is a special instructor : in the infants' department the work is all done by the ordinary class teacher. When handwork is extended to the poor neglected middle—as sooner or later it must be—which system is to prevail ? Is the subject to be taken by a specialist, or is it to take its stand with the ordinary subjects of instruction ? If the school has a manual training room and a manual training instructor of its own, it stands in the most favoured position. If the older boys attend a woodwork centre, that is a second-best. If the children receive no special instruction at all, then are they the least fortunate of all. But whichever of these three classes a school may belong to, manual work is far too important a subject to be handed over entirely to a specialist.

If the class teacher can get the benefit of the advice of a specialist on the spot, so much the better ; if he can relegate the more technical part of the work to that specialist, that is better still ; but in no case should he

entirely relieve himself of responsibility for the expressional work of his class. Nothing can justify the divorce of expressional from impressional process. Nature has wedded them in the very structure of our nervous system; and what Nature has joined together let no educational system put asunder. Doing should accompany learning; it is in fact a method of learning—the most ancient method and the best. It is older than the oldest school, and its lessons are the most difficult to forget. The spirit of doing should permeate the whole school; it should not be imprisoned in the manual training room.

The last question I shall set myself to answer in this chapter is an extremely practical one. If a head teacher finds himself in charge of an elementary school in which the work is almost entirely bookish and academic, how can he proceed to bring the work more into accordance with modern theory? How can he "motorise" the school? There are many bad ways of attempting it; and I will mention what I regard to be the worst. The worst way is to take up one special form of handwork, such as cardboard modelling, segregate it from the rest of the curriculum, and keep the two aspects of school work—the mental and the manual—in severe isolation; to get the wretched handwork lesson over and done with for the week. That is the method of the teacher who still in his heart of hearts believes in the efficacy of talk, but is ready to make a grudging concession to the doctrines of the day. A concession of this kind is of little value. He had better stick to his lecture, his blackboard, and his primer. The teacher who is really in earnest in this matter cannot begin better than by reforming the teaching

of the ordinary school subjects. He should take them up one by one and develop to the utmost their practical possibilities. Arithmetic, geography, and science readily lend themselves to such treatment. Then let him turn his attention to drawing. A movement of reform in the teaching of this subject is at the present day sweeping through our schools. Throw yourself into the full current of this movement. Do not be afraid of it; it cannot carry you astray. Draw from the object as far as may be, and multiply the media of expression. From drawing with the point proceed to brushwork, and from brushwork to modelling in clay or plasticine. In going thus far you have acted on a sound principle of procedure. You have done the work that's nearest. You have started at home. You have polished up the old furniture before ordering in new. You have made the most of the facilities and opportunities already at your disposal; for I presume that most Education Authorities have provided for the automatic supply of the simple materials required for these purposes. You can then say to your Authority, "See what we have achieved! We have done all we can to make the instruction real, vital and abiding; we have made the school a brighter and a happier place for our boys and girls; the atmosphere is more stimulating and the spirit of endeavour has taken possession of our pupils. We feel sure that they are more intelligent, more resourceful, and more original. We have achieved this by giving them an opportunity of doing things for themselves, and finding out things for themselves. Will you help us to proceed further in the same direction?" Such an appeal, if it can honestly be made—as I am sure it can—should be

recognised as a reasonable one. Even if it is refused, what then? Nothing that you have already done is lost. You have got the right atmosphere into the school, and that is the main thing. The most profitable work may often be done with the cheapest of material. Brown paper is plentiful, and clay may almost be had for the asking. The enthusiastic and resourceful teacher can do more with waste material than the perfunctory teacher—the hireling shepherd—with the costliest equipment. Have you considered the value and extent of the field laid open to you in the home lessons? In most elementary schools home lessons are voluntary, which means that they are rarely done at all. Have you tried encouraging your boys to do some handwork at home? If the products are exhibited on the class-room walls as an encouragement to the others, you will be surprised at the rapidity with which the enthusiasm spreads.

We will now assume that your Education Authority is sympathetic and ready to supply material for still more handwork. What is your next step? If you are satisfied that the children have profited by the change that has already taken place, you should introduce some simple form of paper modelling. The only equipment necessary would consist of fairly stiff brown paper, a pair of scissors for each child, and either paper fasteners or some form of adhesive. For children of nine or ten cardboard modelling involving the use of a knife and cutting board should be tried. Then, if you are still more ambitious, you should try strip woodwork with the older boys.

Rather than deal with vague generalities, I have ventured to lay down cheerfully and dogmatically a

definite line along which the handwork should develop. I will reiterate the steps.

1. The ordinary school subjects are rendered practical.

2. The art subjects are amplified so as to include crayon drawing, brushwork, and clay modelling.

3. Simple paper modelling is introduced in the lowest classes.

4. Cardboard modelling is adopted in the next higher classes.

5. Strip woodwork is taken by the older boys.

If any teacher is keen on some other form of handwork (basket-weaving, for instance), he should not hesitate to try it, provided he does not allow it to become too mechanical. Handwork that serves as a mental stimulus is good; handwork that serves as a sedative is flat and unprofitable.

The kind of work advocated in this paper is not the outcome of hare-brained theories which have no foundation in fact, and have never been verified by actual practice. It is based upon principles to which we are irresistibly driven by the recent researches in the physiology of bodily growth and the psychology of mental growth; and wherever these principles have been put into practice they have signally succeeded. The teacher, in fact, who does not believe in manual training, is the teacher who has never tried it.

IV.

DIFFICULTIES AND OBJECTIONS.

In this chapter I propose to deal with objections that have been raised against the further introduction of handwork into our elementary schools. They are not supposititious objections set up in anticipation of a possible critic and forthwith cheerfully demolished just to show how easily the thing may be done. They are real objections that have been urged over and over again at teachers' meetings where I have ventured to advocate the educational claims of handwork.

The first objection is that there is no room for it. The curriculum is so crowded that we cannot possibly squeeze a new subject in without squeezing an old subject out. It has indeed been hinted that the case is almost as serious as that of the fat old gentleman who couldn't take a bath. The trouble was that when he got into the bath there was no room for the water. Manual occupations would take up such an enormous amount of time that there would be none left—or at least insufficient left—for the really important subjects of instruction. The reply is obvious. Handwork is not a new subject: it is a new method of teaching the old subjects. The same confusion between method and subject is to be found elsewhere. Some years ago I visited an infants' school and saw a class drawing with coloured chalks on brown paper. "Drawing lesson, I see," said I to the teacher. "No," was the reply, "not drawing, but kindergarten." Then she enlightened my mind on the matter. When the children

drew with a lead pencil on white paper, that was drawing; when they drew with coloured crayons on brown paper, that was kindergarten. She ended up by saying: "If you don't believe me, look at the time-table." And sure enough, there it was. Kindergarten was put down as a subject of instruction for forty-five minutes per week. And crayon drawing was the interpretation thereof. The teacher's logic was delightfully feminine, and delightfully inconclusive. The kindergarten is, I presume, primarily a place where children grow like plants instead of being edified or built up like houses; but, in England at least, the term kindergarten has acquired a secondary meaning. It means a method by which young children can be taught the various school subjects. And between kindergarten in this sense and educational handwork there is no difference in kind; there is merely a difference in emphasis. As there are some subjects, such as kindergarten occupations, which specially exemplify the kindergarten method, so are there certain subjects, such as cardboard modelling, which specially exemplify the handwork method. But these subjects are not essential to the employment of the methods. Handwork is intended partly to supplant some of the older and less adequate methods. The method of telling has long ago been weighed in the balance and found wanting. To sit still like passive buckets under a pump is no longer regarded as the best way for children to acquire knowledge. Putting in having failed, pulling out was tried. Eliciting came to be regarded as the grand secret of successful teaching, and notes of lessons that were liberally sprinkled with the magic word "elicit" would always pass muster. But eliciting, valuable

as it is in its own province, has obvious limits. The following extract, for instance, from a class master's teaching notes is clearly over the border: "Elicit from the children that iron melts at 2,000° F." A teacher can no more elicit facts from an empty mind than a conjurer can really extract articles from an empty hat. Even the method of direct observation, valuable—nay, indispensable—as it is, is inadequate by itself. More is needed. We must react upon our observations; we must give them some form of expression. Even the youngest of my readers will probably have looked at the face of a clock at least ten thousand times, yet if he tries to sketch the dial he will probably find that the image formed on his mind was anything but accurate. It will possibly have escaped his notice, for instance, that the four does not follow the Roman system of notation. It will have escaped his notice because it is of no practical significance. Our knowledge of the figures on the dial need not rise beyond the recognition point, and IIII. and IV. are equally recognisable as four. We do not, as a rule, observe more than is absolutely necessary for practical purposes. The same principle holds good of spelling. It has often been contended that spelling is a matter of the eye, and is consequently a function of reading; that is to say, a child's ability to spell increases with the extent of his reading. Experience is dead against this doctrine. To learn to spell with ease and accuracy some sort of motor reaction either in the way of writing or of oral spelling is absolutely essential. The learner must know the words not only up to the recognition level but up to the reproduction level, which is considerably higher.

It will now be seen what I mean by saying that motor work—taking in the main the form of handcraft—is not a subject intended to supplant one of the other subjects, but a teaching method intended to supplement the other teaching methods. As such it can be used to vitalise the teaching of Arithmetic, Nature Study, Science and Geography, and to widen the narrow limits of instruction in Art. As such it may revolutionise a school and leave the time-table untouched. It does not, however, follow that handwork could not profitably be carried further. My personal opinion is that a definite time should be allotted to constructive handwork in every class. Now, you protest, I begin to invade the curriculum : the fat man gets his foot into the bath. What then ? Is the commonly accepted syllabus of work so sacred that it must not be touched, or so perfect that it cannot be improved ? What will posterity think of the amount of time we still spend in trying to impart what is known as useful information ? The defence generally takes this form : Surely a boy ought to know something about putty, glass, cork, cocoa, soap, leather, icebergs, palm-trees, camels, and so forth. If so, they should be given lessons upon them. But why stop at camels ? The list of things we think children ought to know is practically inexhaustible. I once had a chat with a schoolmaster, a very capable schoolmaster too, who claimed to be a specialist in object lessons. He said he had a collection of them at home amounting to ten thousand. Nor could we arrive at anything like unanimity respecting the kind and extent of information a child of a given age should acquire. A certain infants' mistress I wot of was of opinion that her five-year-olds should know something

about John Milton. At the request of the inspector his name was removed from the list of conversation lessons. On his next visit he found it among the observation lessons. It had to be got in somewhere.

As a matter of fact, we exaggerate the importance of so-called useful information, especially for young children. Why is it called useful? Useful to whom? Would a youth be quite incapacitated for leading a life of usefulness and dignity if the source of our supply of sago were hidden from him? Should we feel ourselves eternally disgraced if it leaked out that we did not know the process by which glass is manufactured? Has no honourable man gone to his grave ignorant of the chemical composition of putty? If we consider how we ourselves acquired our store of miscellaneous knowledge, we shall probably find that we picked it up as we went along. We got it from reading and from conversation. We consulted encyclopædias when necessary. We certainly did not acquire it at school. I do not contend that lessons on common objects should not be given. What I do contend is that all such object-lessons as do not afford the child an opportunity to come into direct contact with reality and gain a first-hand knowledge of his ordinary environment should be deleted from the curriculum. Information lessons are not, perhaps, intrinsically bad; but they are comparatively bad. We have at our disposal better means of fostering mental growth than by foisting upon the reluctant child insulated facts which satisfy no need in his nature, are in no way usable by him, and stand in no vital relation to those organised systems of ideas that are gradually forming in his mind. Such facts

should be learned, as the words in the dictionary are learned, incidentally—as the need arises.

This is not the only part of the syllabus that can be cut down. In the lower classes of the senior school instruction in Geography is premature and unprofitable unless it takes the form of open-air work, clay-modelling, or, possibly, stories about children of other lands. Astronomical Geography for children between seven and nine is grotesquely out of place. What are we to think of the following Geography lesson which I once heard given to a class of Standard I. girls ? The sole illustration was an apple impaled on a lead pencil. The answers to the questions were demanded in set phrase, after the manner of the Church Catechism.

Teacher : Where is the earth ?

Class : In the sky.

Teacher : What is it doing there ?

Class : Turning round.

Teacher : What is it turning on ?

Class : On its axis.

Teacher : Is the axis upright ?

Class : No, teacher, it is slanting.

Teacher : What is the top of the axis called ?

Class : The North Pole.

Teacher : And what is the bottom called ?

Class : The South Pole.

Heaven help us ! What notions did the teacher have of astronomical position and direction ? And what did a slanting axis mean to these dear little girls ? They would have been much more profitably engaged in listening to the entrancing story of the Ugly Duckling, or dabbling about with paints, or taking a Nature

Study ramble, or with laughing eyes and flushed faces playing a good Old English game.

The above type of lesson is exceptional now: it was typical ten years ago. Quite recently a little girl of eight who could recite with great glibness a long rigmarole about the annual and diurnal motions of the earth, told me that she thought the North Pole was not quite so long as the map-pole but was a little thicker.

Arithmetic, too, is a subject which absorbs too much time in the lower standards. Too much attention is paid to working sums of a fixed type as distinct from gaining an intelligent knowledge of numerical relations.

As for the endless picking out of nouns and verbs, it is almost as tedious as picking oakum, and not very much more educational.

These suggestions suffice to show how room might be made in the curriculum for specific lessons in handwork, although it should ever be borne in mind that these specific lessons are of less importance than the "motorising" of the other subjects of instruction.

Another objection that is frequently urged against practical work is that it increases the burden of the already overburdened teacher. It means harder work and more worry. It makes a greater demand upon his time and puts a greater strain upon his nerves. But does it? Let us consider one by one the unpleasant things in a teacher's life—the things that whiten his hair and wrinkle his face, and sometimes, alas! weigh heavily upon his heart.

First of all comes the inspector's visit. To some teachers that is a constant source of anxiety. There is not merely His Majesty's Inspector, there is the Council Inspector as well. And these inspectors are

prone to hold certain fixed views, which are called ideals by teachers who sympathise with them, and fads by teachers who don't. And between the two the teacher's own particular ideals are in danger of getting crowded out, and his work of being judged by a standard that is new and strange to him. But the inspector is not the autocrat he used to be. He no longer pretends to assess the teacher's work and worth to two places of decimals. Rightly regarded, he is a genial optimist who makes a pilgrimage of the schools seeking for something to praise. He is also a source of infection. He carries the enthusiasm of the living school into the dead school. He is the "hot gospeller" of good methods. And if he is a foe to pretentious imbecility, he is ever a friend to modest merit. How, then, can the introduction of handwork make the inspector's visit more formidable? There are teachers who, mistaking preaching for teaching, immediately fly to "chalk and talk" as soon as the inspector enters the room. They think a show-lesson is expected of them. And of these show lessons I could mention—but that is another matter. In point of fact, what the inspector wants to know is whether the children are being steadily and consistently trained in the best way. Rarely is an inspector so green as to be dazzled by five minutes' pyrotechnics on the part of a teacher. The handwork lesson will not give the teacher much of an opportunity to make a personal display, but it will give the children a chance to show to what extent they have been trained to do things for themselves and to think out things for themselves.

The second source of anxiety to the teacher is the stupidity of the children. He cannot escape it. However bright and intelligent his class may be as a whole,

there will always be found a tail end of comparative dullards. And dulness is the very thing that handwork is best calculated to cure. It is the only means by which we can get at the brain of the idiot boy and strike therefrom a few sparks of intelligence. It is not an infallible remedy, but it is the best remedy we know ; it is a remedy that has succeeded where all other remedies have failed. The older devices are gradually being discarded. The dunces are no longer drilled with spelling and tortured with tables ; they are sent to a special school, where they are trained on handwork. In all special schools for the mentally defective the manual method is the method upon which the teachers mainly rely for stimulating the dormant brain into activity. And the efficacy of the method has been established beyond all doubt and cavil.

Dulness is disheartening to the teacher, but more disheartening still is the apathy shown by a large number of children towards the work done in the school. They take no interest in their lessons. What little work is done is done to avoid a more painful alternative. The delight of learning is not there ; the joy of achievement is not there. To them the oral instruction is wearisome, and the bookwork a bore. But, however pronounced this apathy or indifference may be, it is always partial ; never complete. Complete indifference towards life is nowhere to be found. If it were, it would be a case not for the teacher, but for the doctor. Deep down in the child's nature lie his instincts and native tendencies—the ultimate sources of all his acts and all his thoughts. For his instincts determine his interests. A child is always interested in doing what he has an inborn aptitude for doing. Instinct is the soil in which

interest germinates and takes root. It can grow nowhere else. Its final flower may seem remote and self-sufficing ; but it really receives its support, and no inconsiderable part of its nutriment, from the fertile soil of natural propensity. And if a teacher has failed to arouse a child's interest in a certain subject it is because he has failed to reach his instincts. In the case of manual work the instinct lies close at hand. Every child born into the world has an instinctive tendency to manipulate and construct—to produce with his hands some definite and pleasing change in the physical world that surrounds him. Upon this rock is handwork built. The teacher has not to generate an interest in manual activities. The interest is there already : he has simply to direct it. Have you ever noticed a class of children painting or modelling under the direction of a wise teacher ? They often do not know that you have entered the room, so absorbed are they in their work. Their bright eyes and flushed cheeks, as they proudly show you what they have done, are clear tokens of the activity that has been going on in their brains. Do they like this kind of work ? They more than like it, they love it. And once you get a child to be enthusiastic about anything, the enthusiasm does not stay there ; it overflows to other subjects. Mr. J. L. Hughes, the genial Inspector of Schools for Toronto, once said to me : " There are many ways of kindling a boy. Literature does it with some boys, mathematics with others ; but there is no subject that kindles a boy so readily as handwork." The metaphor is a good one. Once kindle a boy's zeal for any branch of school work, and the fire will spread and spread. And to kindle and feed and foster this fire is the highest work a teacher can do.

Another source of anxiety is bad conduct on the part of the children. As far as mere class discipline is concerned, in the handwork lesson the problem solves itself. For the essence of good discipline is attention. If every child in the class is attending to his work, what room is there for checking and chiding? With the "fold arms" style of discipline I have personally no sympathy. In an oral lesson what does it matter where the little fellow's hands are so long as his mind is at work? If his mind has to be constantly on the alert to curb a restive limb, how can it abandon itself to the essential work of the lesson? As a matter of fact, effective discipline and effective instruction cannot be separated, and both are dependent on attention. If the attention is good the discipline is good.

But sometimes one has to deal with cases of sullenness and insubordination. The remedy for this should be radical; it should aim at nothing short of a complete change in the child's attitude towards his school and his teacher. There is no surer way of bringing this about than in getting him to take a keen interest in some aspect of school work. Once you get his heart on your side the rest will follow. I have known cases of children whose antagonism to the school has been entirely overcome simply by the inclusion of brushwork in the time-table. It was doubtless an occupation which made a peculiar appeal to them. It struck some chord which brought into harmony the whole of their school life.

Finally there is the giant difficulty—the large class. Here at least, it is objected, will handwork afford no relief. Nay, more, it is less suited for large classes than is the ordinary school work. The class-room is neither

a laboratory nor a workshop : it is a lecture room. It is constructed for listening rather than for doing. And, apart from the unsuitableness of the equipment, the distribution of material takes up an inordinate share of the lesson ; and the difficulty of supervision is almost insurmountable. When an Eleatic sceptic tried to prove to Diogenes the cynic that motion was impossible, the latter replied by getting up and walking away. To those who urge the impossibility of handwork for a large class I would suggest a similar sort of refutation. You can see it done, and done daily, and done well, in nearly every infants' school in the kingdom. And if it can be done by children of six, surely it can be done by children of ten, who are far better able to look after themselves. The large class is a real difficulty ; of that there can be no question. But the large class is not a permanent institution. It is an evil which is getting less and less every year. The average size of the class is now well under fifty, and in a very short time it will be well under forty. Even if the class amount to sixty, with a little forethought and a little system the difficulties of distribution and collection, at least, will be found to vanish. The most pertinacious objectors are those who have never tried occupational work. But their evidence is of no greater value than that of the Irishman who was accused of stealing a pig. Five witnesses swore that they had actually seen him do it ; but he undertook to bring forward fifty witnesses who were ready to swear that they had not seen him do it. It is only an Irish intellect that can accept evidence of this kind.

There will be a change not only in the size of the class but also in the character of the furniture. The

desk of the future is, if I mistake not, the flat-topped desk—a desk whose usefulness is far less limited than that of the sloping desk. It is well adapted for manual occupations ; it is not ill-adapted for reading and writing. You and I, dear reader, write on a horizontal surface by preference.

We arrive at the conclusion that the strain on a teacher's nervous system is by the adoption of handwork diminished rather than increased, and that where the difficulties are real difficulties they are such as will gradually be removed by the general trend of educational progress.

There are some teachers, and very capable teachers too, who are out of sympathy with the views expressed above on class discipline. They believe in a policy of suppression, and pride themselves on belonging to the old Stoic school. They lay much store by the disciplinary value of drudgery, and consider that the main duty of the teacher consists in getting the children to do what they don't like. School discipline cuts athwart a child's natural instincts and propensities. Emphasis is placed on muscular inhibition rather than muscular activity. The gist of the educational problem is how to convert muscular activity into mental activity.

This doctrine is supported by tradition and present practice. " Juncti pedes, quietae manus," are the orders of the Pedagogue of Erasmus to his pupil ; " nec vacilles alternis tibiis, nec sint gesticulosae manus." " Sit still and think," says the modern teacher. The doctrine owes its vitality to the fact that it is based on an important truth—the truth that inhibition is necessary for intellectual and moral progress. It should, however, be noted that inhibition is never an end in

itself: it is merely a means. Actions are inhibited simply in order to render other actions possible. The stream is not stopped: it is only diverted. With the adult the diverted stream may easily be made to run into intellectual channels. Not so with the child. In him thought is more closely connected with bodily activity. As for the suppression of natural propensity, that is fatal to healthy growth. Without initial instincts and interests no headway is possible. They are the winds that drive the ship along. Inhibition is merely the rudder. It can generate no force: it can only direct it. To educate a child by entirely thwarting his instincts is no more possible than to run a sailing vessel right in the teeth of the wind. We must tack: we must make concessions. We must make use of a child's likes in order to get over his dislikes. In fact, the aim of the teacher, stated in terms of interest, should be to get the child to do what he likes to do, if it is good; to get him to refrain from doing what he likes to do, if it is bad; and, in the case of distasteful but desirable activities, to get him to like at last what he did not like at first.

If motor training is good for children of tender years, what grounds, it has been asked, have we for deprecating the employment of young children in factories? To urge this objection (it has frequently been urged) is to misconceive the whole purport of my argument. The motor activity I advocate arises out of mental activity; it is accompanied by mental activity, and it is productive of further mental activity. The work is varied and interesting: it is a recreation and a delight. It is neither hard labour nor barren mechanical routine. For not all physical activities are educative. Some,

indeed, are fatal to healthy growth of mind and body. Violent muscular strain, even if it is not injurious to the growing organism, absorbs so much vital energy that there is none to spare for thinking purposes. Even if the child labour that is possible in factory, coal-mine or sweating-den is not hard labour, it is of necessity unskilled labour. It consists of a few mechanical processes endlessly repeated. And the tedium of endless repetition is to child-nature a blight and a desolation. It deadens feeling and stultifies thought. A child is interested in a special kind of act while he is learning it. After he has mastered it his interest in it as an act disappears. He henceforth uses it as a means to subserve other interests. A very young child coos and babbles and chatters for the mere joy of producing sounds until he has got control of his vocal organs. His interest is then transferred from the mere words to the ends to be achieved by those words. And those ends are numerous and varied and speedily attained; and, most important of all, they are his own ends. Even those physical activities which are generally regarded as most closely related to thought are worn threadbare by prolonged repetition. Not only does interest disappear, but meaning disappears as well. Repeat a phrase or a formula for an hour, if you have the patience, and see what happens to it. Or let the reader, as suggested by William James, look at an isolated printed word and repeat it over and over again. "He will soon begin to wonder if it can possibly be the word he has been using all his life with that meaning. It stares at him from the paper like a glass eye, with no speculation in it. Its body indeed is there, but its soul is fled." It will be seen that the factory affords just that kind

of activity which is educationally useless. At its bes it is merely a means of standing still ; never is it a means of moving forward. Besides, the cruelty of it ! Even to the man the dreary round of factory life is dismal enough ; to the child with his hunger for novelty and variety and his peculiar liability to fatigue, it is a veritable " death in life." But there is no danger that the dark days of child labour will ever return. " The Cry of the Children " is a poem whose mission is virtually fulfilled.

So much for an industrial community. Where, however, the conditions of life are more primitive, where man lives closer to the soil and has a wider range of occupations, it is not to the children an unmixed advantage to be captured and put into schools. The farmstead in a primitive community is a place where innumerable activities are constantly going on. Each household is almost entirely self-supporting, supplying its own food, making its own clothing, solving its own problems of shelter, warmth and lighting. The children see these practical processes going on. They frequently take an active part in carrying them out. Thus are they brought into vital contact with the essentials of human society—with the experiences that through countless ages moulded and educated the mind of man. England was like that once. Before the industrial revolution of the nineteenth century the bulk of the population was rural. The home was a place for technical training, the boy being virtually apprenticed to his father and the girl to her mother. And such work as the children did was carried out in the spirit of play, and the jolly open-air life was one of joyous days and of nights " full of sweet dreams and health and

quiet breathing." And so varied and so interesting were the occupations that they constituted an education in themselves, sane and effective and fruitful enough so far as it went, and forming the best preparation for the learning to be got in the school—the acquaintance with those instruments of knowledge (reading and writing and reckoning) which would enable him to extend and communicate the knowledge he had already acquired. He got his motor training on the farm: it was not necessary to duplicate it in the school.

But England has changed since those days. Her people have deserted the fields and crowded into the towns. The urban child of to-day gets little or no practical training in the home, and seldom does he see the solution of any of the abiding problems of life. The need for food is not met by hunting, fishing or gardening; the food is simply purchased at a shop. The home industries are reduced to a minimum. Everything that can be bought at a shop is bought at a shop. At last, for good or ill, we have indeed become a nation of shopkeepers. Time was when the fundamental activities of social life were open to the view; now they are hidden away in workshop, factory and office. The boy sees not his father's daily occupations. Even if he did it would avail him little, for it is generally such a small part of such a big process that its relation to the whole is not seen, and its social significance is not grasped.

This stupendous social change means much to the child. It means that many of the simplest and most fundamental operations of family and social life no longer form part of his environment. It means that the natural stimulus to manual dexterity has disappeared.

It means, in fine, that he gets no effective motor education in the home. And those educative factors which are lacking in the home should obviously be supplied by the school.

It is sometimes insinuated that the advocates of manual training are given to snobbery, that they emphasise social distinctions, that they consider a classical education as the exclusive privilege of the rich, that they hold that the children of the poor should not be educated above their station, but should be trained for those menial duties which Providence so obviously intended them to perform, and so forth. All which wicked doctrines I violently and peremptorily repudiate. It is not for some children that handwork is recommended, but for all children, rich and poor, high and low, good and bad, clever and stupid. It is a vitally important factor in the mental development of every child, whatever his home and whatever his destiny. The boy marked out for a University career needs it no less than the boy who will leave school at fourteen for the factory or the workshop. Practical work is advocated, not because it is practical, but because it leads to a clear and vivid apprehension of theory. It is true that it may be made vocational, just as arithmetic or chemistry may be made vocational, but such specialisation is not contemplated in this book. The power to do things with the hand is a common heritage of the race, and the development of this power is an essential part of a liberal as distinct from a technical education.

Finally, it may be thought by some that this doctrine of motor training is not grounded in a sound philosophy of mind, since the writer does not deal with mind and body as independent entities, seems to seek principles

of explanation on the material side only, and regards intelligence in its early stages as a function of bodily movement, and in all its stages as a function of the brain. This surely, it will be said, is rank materialism. How much nobler in comparison is that view of the mind which regards it as an organism, connected in some way with the body it is true, but capable of growth and expansion on its own lines quite independent of the vagaries of its partner! On this view the best way to train the mind is to deal with the mind directly and leave the body entirely out of account. Give the mind such work to do as is least tainted with the physical and the material. Give it facts to remember, poetry to memorise, problems to solve, difficulties to overcome. This is the only way. There should be no confusion between the discipline of the body and the discipline of the mind. Even in infants' schools the same principle holds good. Games and kindergarten occupations are all very well in their way, but the real mental training is afforded by the formal instruction in the three R's.

In reply it may be pointed out that there is no need for the psychologist to commit himself to any definite philosophic theory. It is his business to deal with things as they seem, not to speculate on the nature of the absolute. The mind he examines is the empirical mind—the mind that reveals itself in the world of time and space. And this mind is in some way dependent on brain. There is no psychosis without its neurosis—no mind change without its corresponding brain change. This is a postulate ; it cannot be proved, but it is accepted as a working hypothesis by psychologists of every shade of philosophic opinion, no less

by the wildest idealist than by the most uncompromising materialist. It is true that there are a few abnormal phenomena which are difficult to reconcile with the theory, but, as far as normal modes of consciousness are concerned, the assumption is fully justified by experience. And the assumption is in no way incompatible with a creed that regards the body as a mere shadow of a shade. It may be that Professor Teufelsdröckh, looking down from his watch-tower upon the passing throng, rightly describes it as a flood of apparitions passing from Eternity onward to Eternity —" souls rendered visible ; in bodies that took shape and will lose it ; melting into air." It may be that each individual soul is infinite in its power and majesty, and that the light of truth radiating therefrom filters but feebly into the work-a-day world through that window which we call the brain.* Or it may be that all souls are in reality one soul, and through each human brain " the white radiance of Eternity " breaks through and illumines the world in which we dwell. If this be true, it is obvious that our main concern in education is with the medium through which the light passes. To increase the illumination we must clarify the medium, we must attend to the window of the soul. Some such conception of the relation between mind and body will help to clear up my meaning when I describe thought as a function of the brain, and less directly and in a more limited sense a function of bodily movement. If we abandon the dualistic standpoint and adopt some form of monism, the position is equally clear. If body and mind are but two different aspects of a reality

* The metaphor is not mine, dear reader. You will find it in Shelley's "Adonais" and in James's Ingersoll lecture.

which is neither the one nor the other, it is obviously a matter of indifference from which side we attack that reality. The teacher who said that he could not always get at a boy's mind, but that his body was always accessible, has expressed my point of view with terseness and lucidity, though he himself was probably referring to another matter. The education of a young child should be approached mainly from the physical side, the emphasis, as he grows older, being gradually transferred to the more purely mental side. And one side is as good as the other provided it is equally effective. Colour is lent to this view by the success of certain recent developments in educational practice. In infants' schools and schools for retarded or defective children—in all schools, in fact, whose aim and purpose is to start an orderly educative process and carry it through its early stages, much attention is being paid to the bodies of the children, not merely from the point of view of health but also from the point of view of motor activity. It may indeed be almost taken as the motto of the modern infants' school that if we take care of the body—see that it is wisely employed—the mind will take care of itself.

It will thus be seen that the objections that have been urged against the theory of occupational training are feeble and unconvincing; and that the difficulties that are alleged to lie in the way of carrying that theory into practice turn out to be either imaginary or grossly exaggerated. But granting that there are difficulties, the worthiness of the aim calls for a stubborn effort to overcome those difficulties. For the method that was mainly instrumental in humanising the race is no mean method. We are what we are to-day by

reason of the arts, crafts and industries of our forefathers. It was their manual occupations that overcame the brute resistance of savagery—that broke the back of the work of civilising mankind. It prepared the way for the dreamer of dreams and the seer of visions. And every living man is more truly the product of what he has done for himself than of what he has heard or seen or read. It is in the storm and stress of circumstance that the finest souls are fashioned. The man who wrote Hamlet was an actor—"a poor player that struts and frets his hour upon the stage." As a Welsh preacher once pointed out, it was Absolom who had the poet's hair and the poet's leisure; but it was David who wrote the Psalms.

V.

AMBIDEXTERITY.

It was Plato who first mentioned it. You will find the passage in the Laws vii. 794 :—

"The right and left hands are supposed to differ by nature when we use them ; whereas no difference is found in the use of the feet and lower limbs ; but in the use of the hands we are in a manner lame, by reason of the folly of nurses and mothers, for, although our several limbs are by nature balanced, we create a difference in them by bad habit. In some cases this is of no consequence, as, for example, when we hold the lyre in the left hand and the plectrum in the right ; but it is downright folly to make the same distinction in other cases. The custom of the Scythians proves our error ; for they not only hold the bow from them with the left hand and draw the arrow to them with their right, but use either hand for both purposes. And there are many similar examples in charioteering and other things, from which we may learn that those who make the left side weaker than the right act contrary to Nature" (Jowett's translation).

From that time onward, at varying intervals, men have arisen and proclaimed to the world as an important discovery the fact that we use one hand more than the other. They have added as an obvious corollary that such preferential treatment is irrational. It is within the memory of some of my readers that Charles Reade started in the *Daily Telegraph* a controversy that raged furiously for a short time and then suddenly

dropped. And the land rested from thoughts of sinistral and dextral until in 1903 the Ambidextral Culture Society was inaugurated. Then appeared an epidemic of literature on the subject. In America the craze has waxed and waned, has had violent advocates and equally violent opponents. What is more to our purpose, it has invaded the schools, in the matter of drawing at least. A few short years ago ambidextral drawing was the latest thing in our infants' schools. It was regarded as the hall mark of up-to-dateness. It is now gone with " the snows of yester year."

The advocates of ambidexterity claim that we can not only make ourselves more useful by cultivating two-handedness, but that we can considerably increase our brain power. For in disturbing the symmetry of our limbs we have also disturbed the symmetry of our brains. We are not only right or left-handed : we are also left or right-brained. The cerebral hemisphere that controls the unskilled hand is always under-developed. This, they say, is deplorable. We are less than we might be. But the remedy is easy. Train the unskilled hand. If you bring both hands to the same level of efficiency, it is argued that you will bring both halves of the brain to the same level of efficiency. Many a man has done so—as far as his hands are concerned at least. General Baden-Powell, for instance, can write and draw just as easily and just as skilfully with his left hand as with his right. We are asked to believe that this has something to do with his level-headedness. We are further told of certain fearsome people who can write two letters on entirely distinct topics at one and the same time. One of these prodigies can with his right

hand indite a tender note to his sweetheart and with his left scribble an abusive letter to his landlord. The story is told of Sir Edwin Landseer drawing two things simultaneously. With one hand he sketched the head of a stag and with the other the head of a horse. It is claimed that the two halves of the brain may be trained to work independently. It has even been hinted that one may be got to play a stiffly contested game of chess with oneself, or carry on a hot political argument between the right hemisphere and the left. To marry under the circumstances would, in some respects, be a superfluity.

Other advantages are claimed. Ambidexterity insures against fatigue and accident. One hand can rest while the other works. If either hand were injured or paralysed, the other could act as a substitute. With the ordinary man the left hand is a bad understudy to the right. Lambroso found criminals in many instances exhibiting an extraordinary degree of physical lop-sidedness. *Caveat unidexter.*

In view of the demerits of what we may call unidexterity, or one-handedness, the Ambidextral Culture Society strongly urge that the children in our schools be taught to write, draw, paint, sew, and use the various manual training tools with both hands equally.

What are the real facts of the case ? It is estimated that the bulk of European adults (about ninety-seven out of every hundred) are right-handed, and the rest left-handed. Mr. John Jackson, the secretary of the Ambidextral Culture Society, asserts that 97 per cent. of English people are right-handed, 17 per cent. congenitally right-handed, 3 per cent. congenitally left-handed, and 80 per cent. naturally either-handed. It

would thus seem that some are born right-handed, some achieve right-handedness, and some have right-handedness thrust upon them. Most children, according to Mr. Jackson, show no initial tendency towards the preferential use of either hand, but are trained by their mothers nurses and teachers to use the right hand in conformity with social custom.

The opponents of ambidexterity deny that any child is naturally either-handed, and contend that before he is able to walk, before he is one year old, he shows unmistakable signs of unidexterity.

The truth seems to be that all mankind have an inherent tendency to use one hand more than the other (generally the right), that this tendency is much stronger in some people than others, that it is usually accompanied by a similar predominancy of eye, ear, and foot on the same side, and that it matures within the first few years of infancy, and becomes fixed by imitation and practice. Everybody, in fact, is either a born dextral or a born sinistral. The few who seem to approach the ambidextral ideal are as a rule left-handed people who have endeavoured to conceal their sinistrality.

The left hand of the ordinary mortal is much maligned by the Ambidextral Culturists. They call the right hand the useful hand and the left the useless. Such a distinction is manifestly absurd. Ask a pianist, or a violinist, or a surgeon, or a tinker, or a tailor, or indeed anybody of normal physique whether he finds the left hand useless. Keep the left hand in a sling for a day and note the consequences. As a matter of fact the two hands collaborate : they share between them the business of the hour. And in any given piece of work each has its own special duties to perform. And by

thus specialising each acquires its own particular kind of skill. If you try to eat your dinner with the knife in your left hand and the fork in your right you will find the right hand just as awkward with the fork as the left is with the knife. There are some things which you can only do with your left hand—scratch your right elbow for instance. And there are many things that one can do with greater facility with the left. It is true that the left generally plays the humbler role, but it is a role necessary for the success of the piece. In fact the two hands rarely act as independent units: they form a partnership, and there is between them, as there should be, a differentiation of function.

Many observers have thought that they have discovered some sort of dextrality or sinistrality among animals. Livingstone, for instance, held a belief that all lions were left-footed. But these opinions are unsupported by evidence. Even if there were an inherent superiority in one limb over another, such superiority would be difficult to detect, for even a man's right-handedness or left-handedness is concealed from us until we see him use a tool of some sort, such as a pen, a knife, or a hammer. It is indeed probable that if man had not been a tool-using animal he would never have known his right hand from his left. It is confidently asserted by Grant Allen that Primitive Man was ambidextrous. He bases his assertion on the ground that the cave man drew just as often and just as well with his left hand as with his right. If you take a pencil-stump between your finger and thumb and try to draw a human profile in the most natural way you will find the face turned towards your left shoulder; if you try with your left hand the face will be turned towards

the right. Children and savages always draw in this way. The earliest men of whom we have any definite and scientific knowledge were wont to etch with sharpened flint on bone or ivory the profiles of men and beasts turned indiscriminatingly to the right or to the left. The inference is that they were ambidextrous. But the inference is not irresistible, for unless it could be shown that the animals looking rightward and the animals looking leftward were drawn by the same artist the utmost that the evidence could be made to prove would be that left-handed people were more numerous in those days than in modern times. The balance of probability is, however, in favour of Grant Allen's theory. It is fairly certain that if we could get far enough back—if we could get to the time when mankind first assumed the upright posture we should find the bulk of them ambidextrous, or, if you prefer to call it so, ambisinistrous. They were equally awkward with both hands. Gaucherie was the order of the day. How then did the race become right-handed? There are really two questions involved. First, how did ambidextrous people become unidextrous? Secondly, why should unidexterity have taken the almost universal form of right-handedness? Regarding the matter from the point of view of Natural Selection, it is clear that in the struggle for survival the unidextrous people must have possessed some sort of advantage over the ambidextrous, and of the unidextrous the right-handed some sort of advantage over the left-handed. What was the nature of this advantage? It is useless seeking for an explanation within historic times, for right-handedness was well established in the human race long before the earliest period of which

we have any written record. No tribe or nation, savage or civilized, has ever been discovered which is not predominantly right-handed. Even the seven hundred left-handed Benjamite slingers referred to in the Book of Judges formed less than three per cent. of the whole tribal army. Dr. Mott, who is a recognised authority in this matter, maintains that the ambidextrous savage would show some degree of hesitation at critical moments —moments when to hesitate would be fatal. If, for instance, at the sudden approach of an enemy, he showed the slightest indecision as to which hand he should use for picking up his spear, he would give his enemy the overwhelming advantage of getting in the first blow. It is not implied that he would stand like the hypothetical donkey between two bundles of hay; it is not implied that there would be conscious deliberation on his part; but it is implied that where there were two equally permeable channels of customary response to a given situation, the actual response would not be of such lightning rapidity as it would be if there were only one channel. And this is a case in which a fractional part of a second might make all the difference there is between slayer and slain. As the doggerel rhymster puts it:—

> "Thrice is he armed who hath his quarrel just—
> But blest be he who gets his fist in first."

There is another, and more cogent, reason why the unidexter should be better fitted for survival than the ambidexter. He was more skilful. There is no reason for thinking that the earliest members of the race exercised their bodies with the conscious aim of acquiring bodily prowess. The only practice they got was forced upon them by the pressure of circumstance.

In hand-to-hand contest with his kind, or in the precarious hunt for animals that supplied food or clothing, a premium was laid upon bodily skill. His life depended on success in the one sphere, his livelihood on success in the other. The time devoted to practice was therefore virtually the same in all cases. And given the same amount of time, the degree of skill attained by practice with one hand only would be greater than if the practice were distributed among the two hands. The unidexter concentrated on one.

This accounts for the extinction of the ambidextrous ; but how are we to account for the fact that unidexterity took the almost universal form of right-handedness ? The most reasonable explanation seems to be that right-handed people were better able to protect the heart. We cannot suppose that it took our primeval ancestors very long to discover that wounds on the left side of the body were more dangerous than those on the right. Even before the use of weapons it was observed that a well-directed blow over the left breast was sometimes sufficient to cause death. The fighter (for whatever else he was, primitive man was of necessity a fighter) had therefore to protect that specially vulnerable region at all costs. This was done with the left arm while the right did the bulk of the fighting. When man became sufficiently civilized to use weapons of war, the shield was held on the left arm so as to cover the heart, and the right hand was set free to do what execution it could with club, spear or sword. Thus did the right hand acquire an adroitness which the left hand had no opportunity of acquiring. And thus did the right hand begin to gain its superiority over the left. The balance between right and left once

destroyed, the growing arts and industries but tended to make the disparity wider and wider. To account for the facts it is not necessary to assume the transmission of personally acquired characteristics, for natural selection—the dying off of the unfit—affords a sufficient principle of explanation.

The tendency to weed out the left-handed by such drastic methods as natural selection implies would become less and less as civilization advanced; for in the pursuit of the arts of peace the left-handed man would suffer no disability. Some slight social prejudice still remains—a prejudice made manifest in the various meanings that have clustered round the word "sinister." Nor is left-handedness without certain minor disadvantages. These are mainly due to the fact that it is exceptional. As one example out of many, I may mention that the ticket pocket in a man's coat is so placed as to be readily accessible by the right hand only. The left-handedness of to-day has probably been transmitted down the ages from very remote ancestors. The theory of its hereditary nature is supported by the fact that it tends to recur in certain families.

Thus has Nature presented us with a standard of values. She gives the first place to right-handedness; left-handedness comes second, and ambidexterity makes a bad third. Many are inclined to accept Nature's pronouncement as final. Grant Allen, for instance, is emphatic on the point:—

"Man's special use of the right hand is one of his points of superiority to the brutes. If ever his right hand should forget its cunning, his supremacy would indeed begin to totter. Depend upon it, Nature is wiser than even Charles Reade. What she finds most useful

in the long run must certainly have many good points to recommend it."

Ruskin, whose prejudice against Darwinism was as deep-rooted as Grant Allen's prejudice in its favour, found justification for his fondness for the Gothic curve in the fact that Nature had multiplied it in all the grasses of the field and all the leaves of the forest. Abraham Lincoln's rebuke to the man who called him common-looking was dignified and just : " The Almighty prefers common-looking people—that's why He made so many of them." Apart from any religious implication, Lincoln's remark embodies a deep biological truth. Nature has set her *imprimatur* upon the many.

But we are not obliged to accept Nature's standard of values. As a matter of fact, man never has accepted it since the days when he first evolved an ethical creed. Not in Nature is to be found the springs of " admiration, hope and love," but in man.

" Who trusted God was love indeed,
And love Creation's final law—
Tho' Nature, red in tooth and claw
With ravine, shriek'd against his creed."

Matthew Arnold strikes a true note when he says :—

" Man must begin, know this, where Nature ends ;
Nature and man can never be fast friends."

We talk glibly about the survivial of the fittest, often forgetting that " fittest " merely means " fittest to survive." There have been conditions under which the finest flower of humanity could not possibly flourish, when Nature put a premium on those harder and cruder qualities which have, since the advent of Buddhism and Christianity, had to take a much lower place in the scale of virtues. Man's social values do not equate with Nature's values. To the brute creation Nature is indeed a mother—a cruel mother often, but still a

mother; to man, whose spiritual nature is of alien birth, she is at best nothing more than a kindly step-mother. Man is not entirely the victim of circumstances; he makes circumstances for himself. He is not only adapting himself to his environment; he is constantly adapting his environment to himself. In fact, he imposes his own ideals upon Nature, and is himself becoming a more and more important factor in determining the general trend of things. There is no finality, therefore, in Nature's verdict. It may well be that the conditions necessitating the extinction of the ambidextrous no longer exist, and that characteristics which were impossible in primeval times are not only possible but desirable in these latter days.

On evolutionary grounds alone, therefore, I should not be inclined to condemn the ambidextral doctrine. If there were no other reasons for rejecting it I should regard it to be at least worthy of careful experiment. But there *are* other reasons—reasons connected with the mechanism of speech. Within some of the areas of special brain functions referred to in an earlier chapter there are more highly specialised centres called word centres. Within the visual region, for instance, there is a definite centre for words, and words only. It is through activity in this centre alone that words seen in a book are invested with meaning. If this centre were destroyed the patient would see the words as before, but would be unable to understand them; they would be to him mere meaningless hieroglyphics. Similarly, to those devoid of the auditory word centre all human speech would be "like a tale told by an idiot, full of sound and fury, signifying nothing." There are four such specialised centres directly connected with

language—the auditory, visual, vocal and graphic word centres. The two former are purely sensory, the two latter both sensory and motor. The two former are concerned with the interpretation of words heard or seen, the two latter with expression in spoken or written language. They may be called respectively the listening, reading, speaking, and writing centres. It is obvious that they are closely inter-related. Activity in one involves activity in some at least of the others. As I write these words, I am using the visual word centre and the writing centre; but the other two are not idle. Although the auditory centre is not perceptually active—although, that is, I do not actually hear the words spoken—it is ideationally active, it is sufficiently active to enable me to imagine I hear the words spoken. And although I do not actually speak the words aloud there is a tendency to do so, a nascent innervation of the vocal muscles, to say nothing of motor images, the revived memories of previous utterance. This sympathetic excitement of the speech centres tends to enliven and enrich the stream of meaning which accompanies discourse.

We now come to deal with an important physiological fact—the fact that the language centres are found on one side only of the brain. One hemisphere is more highly developed than the other, and that hemisphere normally contains the speech centres. The visual centre is bilateral, the visual word centre is unilateral. The same is true of the auditory and vocal centres. If you are naturally right-handed you are naturally right-eyed and right-eared as well, and you will have three out of your four speech centres fixed for you by Nature in your left hemisphere. The fourth—

the writing centre—you can fix for yourself in either hemisphere. If you learn to write with your right hand you will locate it with the others in the left hemisphere ; but if you learn to write exclusively with your left hand (a highly improbable event) you will locate it in the right hemisphere. Now imagine the case of a congenitally left-handed person who has in the teeth of his natural tendency been taught to write with his right hand. Three of his speech centres will be organised in the right hemisphere and one in the left. But when a person is engaged in writing, the language centres always work together. They form a committee of four who are for the time being in constant communication with one another. In normal cases the committee sit in one room ; but in the case of the man who habitually writes with his awkward hand three members sit in one room and one in the other. It is true there is telegraphic communication along the commisural fibres from one room to the other, but it is not reasonable to believe that they can work together as harmoniously and expeditiously as though they were all in one room. It must be borne in mind that nerve currents take time to travel. Light is instantaneous in comparison. Even sound travels about ten times as fast. If, in fact, the conclusions of Helmholtz and other German experimenters are well grounded, currents are transmitted along our nerves at the rate of about 75 miles an hour ; that is, but little faster than an express train. The comparative slowness of this speed can best be realised by an example. Point your finger to the sun. If that finger were suddenly extended so that it touched the sun and got burnt at the tip you would feel the pain in about 140 years. Even if these results are unreliable, there can be no doubt

whatever that neural stimulation takes an appreciable time to pass along the fibres of the nervous system wherever situated, and that the brain excitation which accompanies thought can pass from one speech centre to another more readily when those centres are on the same side of the brain than if the whole breadth of the brain separated them.

Akin to this consideration is the question of blood-supply. Thought is always accompanied by a determination of blood to the head, as can be abundantly demonstrated by means of an ingenious piece of apparatus invented by Mosso. It consists of a delicately balanced table upon which the subject to be observed is made to lie at full length. It is so adjusted that when the subject is in a state of intellectual inactivity—not thinking about anything in particular—the table remains perfectly level. If he is asked a question his head immediately sinks. The more intense the mental effort involved in answering the question, the greater is the amount of the dip. If the subject goes to sleep, down go the feet and up goes the head. This shifting of the centre of gravity of the body can only be ascribed to fluctuation in the supply of blood to the head. Although no positive proof can be adduced, it is highly probable that activity in the various brain centres is always accompanied by an afflux of blood to those particular regions. It would, moreover, seem reasonable to suppose that the mechanism of circulation would work more economically if the centres that habitually functioned together were in close proximity than if the special blood-supply had to be sent to two remote quarters of the brain.

These speculations are not unsupported by facts. Dr. G. M. Gould, of Philadelphia, records the case of a

naturally left-handed friend who was compelled when a child to write with his right hand. For all other acts he was left-handed. All through his life he hated writing, and never seemed to be able to use his pen and his brain at the same time. If he tried to write while thinking there was a positive inhibition of thought. But as soon as he laid down his pen and started dictating to a stenographer his ideas flowed freely and rapidly. Some time ago I came across two bad cases of stammering in the same school. Both were naturally left-handed boys who, having learnt to write with the left hand had been constrained by their teachers to change it for the right; and both had acquired the stammer during their school career. Doctor X told me the case of his little boy whose speech was delayed for two years by what he now regards as an ill-advised attempt to change the child's sinistrality. The Dale system of teaching reading, admirable as it is in most respects, has one feature of very questionable value. The child is encouraged to use both hands alternately in writing, printing and drawing. Most teachers who have adopted the Dale system have found it wise to discard the ambidextral factor. These data, meagre and insufficient in themselves, help to confirm the view that there is an intimate connection between dextrality and language, and that attempts to disturb the natural unidexterity of the child tend to disorganise the function of speech. And this disorganisation is far-reaching in its consequences. For language is an indispensable instrument of conceptual thought. The old question of the dependence of thought upon language need not be raised here. It is sufficient to state that a prolonged train of thought cannot be maintained without the support of

some sort of language ; and the older we grow the more closely does our mental imagery approximate the purely verbal type. We seem therefore to be driven to the conclusion that the cerebral hemisphere that contains the speech centres is the cerebral hemisphere that does the bulk of the thinking. If this is so, and if this is inevitably so, it is manifestly unwise to deprive that hemisphere of the culture that comes from the judicious use of that hand which is organically connected with it.

I have given what seems to me to be the most rational explanation of the prevalence of right-handedness, and have deduced therefrom reasons for maintaining the *status quo*. This explanation is not universally accepted. In fact nearly a dozen different theories of right-handedness have been put forward at one time or another. The bulk of those which do not merely restate the original problem are based upon the unsymmetrical arrangement of blood-vessels and viscera. One theory for instance, describes the predominance of the right hand to the predominance of the left hemisphere, and the predominance of the left hemisphere to the fact that blood reaches it from the heart in a straighter and less impeded course than the blood that flows to the right hemisphere. Another theory lays stress upon the fact that the viscera on the right side of the body are heavier than those on the left, and its advocates pretend to find therein a reason for the superior skill of the right hand. It is all due to the liver. That is the heavy organ that disturbs the balance. So the range of responsibility of the liver is greater even than we suspected. It may be said at once that these arguments based on physiological structure break down through

proving too much. They would prove, for instance, that all animals whose general internal arrangements were similar to ours ought to be right-handed or right-footed ; that a left-handed man is a physiological freak ; and that cases of transposition of the viscera would always involve left-handedness. None of these deductions correspond with fact. Dr. Gould in the article already referred to mentions nine theories and maintains that the Topsy theory—the theory that it " just growed "—is as satisfactory as any. I presume he means that we have grown right-handed as a race, for he refers to the Ambidextral Culture Society in the following terms : " The organisation might better call itself the society for nullifying the law of the differentiation of function necessary to all progress, for returning to barbarism in the handicrafts, and for life-long cruelty to the left-handed." He himself attaches much importance to what he calls dextrocularity. He regards the predominance of the right eye as the initial fact. We are right-handed because we are right-eyed. In playing the fiddle the fingering is done with the left hand, for it is thus that the right eye can the better observe the movements. The weakness of this doctrine is that it is formulated to explain that which needs no explanation by means of that which does. For while we have no satisfactory theory of the origin of dextrocularity, we have a fairly convincing theory of the origin of dextrality. Moreover it is open to the fatal objection that people blind from birth show the ordinary preference for the use of the right hand.

Sir James Crichton-Browne ascribes all dextral and sinistral phenomena to the root fact that the hemispheres differ in shape and function. The two halves

of a rabbit's brain are as indistinguishable as the two cheeks of a young baby ; but in the brain of an anthropoid ape there begins to appear a lack of symmetry in the ridges and hollows of the two hemispheres. This divergence is seen to increase as we pass to higher and higher types until it reaches its maximum in the brain of civilized man. And this difference in structure is the correlative of a difference in function. Sir James accepts Dr. Hughlings Jackson's doctrine that in ordinary people the left hemisphere is the more voluntary and the right the more automatic. This, and this alone, accounts for the ascendancy of the right hand and the unilateral position of the speech centres. He says we can go no further : we must accept this cerebral peculiarity as an inexplicable and ultimate fact. We are here face to face with another form of the old problem of the chicken and the egg. Which came first ? Did the supremacy of the left hemisphere secure the supremacy of the right hand ? Or did the preferential use of the right hand secure in the course of ages a better education for the left hemisphere ?

Leaving these somewhat barren speculations, let us turn our attention to two practical questions that clearly emerge from the controversial fog. The first is : How shall we deal with a left-handed child ? The other is : Shall we teach our children to write and draw with both hands interchangeably ? With regard to the first question there is one point upon which both parties are happily agreed, and that is that there should be no attempt to make the child right-handed. From this point their opinions diverge. The advocates of ambidexterity say : Let him write with his left hand, but teach him to write with his right as well. But

their opponents say: Do not interfere with him at all; let him always write exclusively with his left hand. And this is unquestionably the wiser counsel.

The second question, which is, in fact, the crux of the whole controversy, can be more definitely answered after a closer examination of the alleged advantages of ambidexterity. It is first of all asserted that we should be more generally useful if we were equally dexterous with both hands. Surgeons and boiler-makers are instanced as finding left-handed skill extremely serviceable. If all the boys and girls in our schools were destined to be surgeons or boiler-makers the argument might be worth considering. There is, in fact, no objection to training the left hand in its own sphere of usefulness; for the usefulness of the left hand is, as a rule, different in kind from the usefulness of the right. The left hand is useful for steadying the paper while the right hand holds the pen, for holding the cigar while the right hand applies the lighted match, and for playing on the piano the notes in the bass clef while the right hand deals with the notes in the treble clef. Instances of this differentiation of work may be multiplied indefinitely. There is a certain low level of serviceableness which both hands may profitably attain. We ought, for instance, to be able to pass the butter just as readily with the left hand as with the right. But when it comes to delicate manipulation we wisely specialise.

The next contention, that we can double our brain power by merely training the left hand is quite unsupported by evidence. There is no proof that the trained ambidexter has one jot more intellectual capacity than he had when he was unidextrous. He can write two

scripts at the same time. But that is a mere trick. The specimens that appear in Mr. Jackson's book on Ambidexterity are entirely unconvincing. They reveal no originality, except in spelling. They were not really simultaneous, they were merely alternate. A bit of A was written, and then a bit of B, then another bit of A and another bit of B and so forth. Even if the two writings seemed to be severally continuous, it is evident that the thinking was not continuous. The attention was not split up into two parts, each part undertaking its own special task; it simply oscillated from one task to the other. Genuine cases of dual personality and of split-off consciousness are not unknown to psychologists. But these are pathological.

We are told that ambidexterity is a kind of insurance against injury to the right hand. It is the logic of the old lady who bought at a sale half-a-dozen crutches, on the ground that they would come in very useful should her dear husband happen to get his leg broken.

The word "lop-sided" continually recurs in the literature of the Ambidextrians as a term of reproach. Nature, they say, has made us symmetrical, but we have made ourselves lop-sided. But *has* Nature made us symmetrical? In internal structure we are terribly out of balance. Even the two halves of our brain are not similarly convoluted. And if Nature has made us structurally one-sided, why not functionally as well? Nature indeed has no great love for either absolute similarity or absolute symmetry. She does not like to repeat herself without some variation—not even on both sides of a straight line. She draws no line down the middle: she designs no South Kensington drawing copies. Let us be content, then, to remain a little

lop-sided like the rest of Nature's handiwork, remembering—if it gives us any consolation—those words of Bacon so constantly quoted by Edgar Allan Poe: "There is no exquisite beauty without some strangeness in the proportion." So in the matter of beauty, dear reader, a *soupçon* of lop-sidedness is one's only chance. It is said that the swiftest runners have limped a little: one leg has been a trifle stronger than the other. And the most artistic of nations, such as the Assyrians and the Greeks, have shown the most pronounced tendency to dextrality. The Japanese, far from being the ambidextrous race they are asserted to be by the Ambidextrians, are so inveterately right-handed that when Jingors, one of their great wood-carvers, was found to be left-handed they nick-named him Hidari—the Sinister.* Among the great masters of painting in Europe, Leonardo da Vinci was the one left-handed exception. And there were no ambidexters. Nor is there any record of a left-handed or ambidextrous sculptor.

Why, we are asked by the Ambidextral Culturists, should our speech centres be confined to one half of the cerebrum? Why should we not have two series, one in each hemisphere? They assert that the speech centres have been dragged to one side by an artificially acquired right-handedness. Even if we admit that down the long line of human evolution the right hand has been instrumental in establishing the supremacy of the left hemisphere, we can admit the existence of no such potency in the right hand of the individual. The supremacy of the left hemisphere is now innate—it takes the lead by right of heredity. It is very possible

* See Sir James Crichton-Browne's lecture on Ambidexterity

that the speech centres are of necessity unilateral, that they cannot co-exist in both hemispheres. This is a point upon which physiologists have not yet enlightened us. Human ambidexters are few, and their brains have not been available for examination and experiment. The only ambidexters that have been vivisected, such as monkeys and rabbits, have had no speech centres at all.

We arrive, therefore, by a variety of routes at the conviction that the Ambidextrians are wrong; and that their doctrines are opposed to tradition, to the requirements of social and industrial co-operation, and to the teachings of modern biological science. Civilization and right-handedness have arrived together. The history of the one is the history of the other. And as the members of the body politic have shown a progressive tendency to specialise, so have the members of the body physical. In that way efficiency lies. Apart from considerations of manual skill, the gift of dextrality is tied up with the gift of speech. The cerebral springs of speech are one system, just as the soul is one and attention is one. To disorganise dextrality is to deprive this lingual system of some of its natural stimulus, and possibly to imperil its unity. Let not the right hand, nor yet the left, forget its cunning; neither let one hand usurp the province of the other.

THE FUNDAMENTAL SCHOOL SUBJECTS.

THE most valuable contributions to educational theory have been due to looking at the teachers' work from a new point of view. And to look steadily at a familiar thing from an unfamiliar point of view is one of the most difficult things in the world. Dr. Johnson, the embodiment of the colossal common sense of the eighteenth century, once remarked that everything that was to be known about education had already been discovered—a statement which indicates that he failed to get a view of the subject which in any way differed from that of the ordinary man of the period. To the layman the problem of education is extremely simple; it is as simple as asking the way to the railway station. The man who doesn't know asks the man who does; and the man who does tells the man who doesn't. It is merely a matter of telling. When Froebel, in the early part of the nineteenth century, broke away from this naïve theory and dealt with the educational problem from the standpoint of the spontaneous activity of the child, professional theory and practice began to march steadily forward. And when Herbart dealt with the subject from the standpoint of interest the advance received still further stimulus. Such progress, in fact, as is taking place at the present day is mainly dependent for its motive force on these two men. This by way of illustrating my point that if we are to deal with the subject under consideration in a way that will be productive of real and permanent good, we must get hold of some broad underlying principle of unquestionable validity, and, clearing our minds for the time

being of all preconceived ideas, look at the whole problem with fresh and unprejudiced eyes. To get this freshness of vision we must secure a standpoint which is more or less new, or at least which is different from the one to which we are most accustomed. There is much that prevents us from doing this. The first obstacle has already been indicated—the familiarity of the subject-matter. The second is the tyranny of tradition. Certain branches of instruction have from time immemorial been regarded as of primary importance—the three R's, for example—while others, such as singing, drawing, and physical exercises, were considered of quite subsidiary value. We have only to go back forty years to find the three R's constituting the normal scope of the elementary curriculum, with all the other subjects labelled "extras." The bulk of the rural schools were content to be normal. Reading, writing, and arithmetic have thus acquired a prestige which we rarely think of calling into question.

Another formidable obstacle consists in the baleful influence of examinations when raised from their natural subsidiary position to a place of primary importance. In the days when each child in the school had to be submitted to individual examination by Her Majesty's Inspector it was but natural that those subjects should be held in highest repute which most readily lent themselves to examination—which were most examinable. Reading, writing, spelling, and mechanical arithmetic could easily be examined, and the results worked out in percentages, but it was by no means easy to assign marks to that vague quality known as intelligence. The geography which consisted in memorising names and isolated facts, could be tested and given a measurable

meed of praise or blame, but that geography which was based upon first-hand knowledge of typical portions of the earth's surface and practice in discovering rational connections between facts physical and political did not so readily adapt itself to the examiner's measuring tape. Instances might be multiplied. Parsing and analysis were popular, composition unpopular. Symmetrical drawing from the flat was assiduously practised; drawing from the object and expressional drawing, entirely neglected. Oral composition was unheard of, except of that surreptitious form which was punishable by the cane. It was not the fault of the inspector, it was the fault of the system. The inspector had to get through a certain amount of work in a given time, and he did it in the only possible way: he mechanicalised the work as completely as he could. We have not yet emancipated ourselves from the tradition of that period. Formal grammar, unscientific geography and rule-of-thumb arithmetic are still dear to the heart of many a teacher; and many more there are who refuse to have any dealings with such wicked inventions as Nature study, story telling and handwork. Those older doctrines, if doctrines they may be called, not only defeat the very end and purpose of schooling—the cultivation of rational interests—but also darken the days of the younger children and rob them of much of their natural heritage of joy.

A further obstacle in the way of taking up the matter *de novo* is to be found in the prejudice that exists against work done with the hands. Education, in popular opinion, is a thing of the mind: it deals with consciousness and with consciousness alone. You may cultivate the body if you like, or you may cultivate

the mind; but these processes in no way help each other: they are, in fact, antagonistic. One can only take place at the expense of the other. Thinking is unhealthy, and manual work stupefying.

But to regard the mental and physical—the soul and the body—as in any way opposed to one another is to hark back to an obsolete psychology. Plato, in his wonderful dialogues, constantly refers to the soul as an entity whose real home is that perfect land of truth and beauty where all things are intuitively known—a land beyond the clouds from which we came when we were born, and to which we will return when we die. This soul, he says, is for some mysterious reason imprisoned in a body of clay. Its perceptions are dimmed, its memories are obscured, it finds itself "cribbed, cabined and confined" by the vile prison in which it is pent. The duty of the philosopher is to escape as far as may be from the bondage of the body. His life is a continuous act of dying. "I," says Epictetus, "am a soul dragging about a corpse."

There can be no doubt that this doctrine contains many elements of truth, but the notion of a complete antagonism between mind and body is entirely opposed to modern views. The soul, so far as this world is concerned, can only manifest itself through the brain and the body. If there is no change in the brain no change is manifested in the mind. Every mind change means a brain change; all mental activity implies cerebral activity as well. The reverse, however, is not true. It is not every change in the brain that produces a change in consciousness. Ribot, the French psychologist, describes the brain as a sort of underground laboratory where numerous activities are constantly

taking place, but only very few of these ever rise above the surface and enter the region of consciousness. We must allow for what used to be called unconscious cerebration.

Modern psychology, in fact, never attempts to divorce itself from physiology. The modern psychologist does not say that changes in the brain are the cause of thought, or that thought is the cause of changes in the brain. What he does say is that both go together: that there is a parallelism between them. You cannot educate the brain without educating the mind as well, and you cannot educate the mind without educating the brain as well. It does not matter, then, very much whether we look at an educational problem from the brain side or from the mind side.

Having—provisionally, at least—purged our mind of these four prejudices, we will proceed to look at the curriculum from a point of view which has been supplied by Herbert Spencer. He defines life as correspondence with environment; and in defining life he has defined education as well. For education is merely an attempt to concentrate experience: it is a Liebig's extract of experience. Life is adjustment to environment. Here is the animal on the one part, and on the other the setting of air, field, forest and flood with their multitudinous denizens. In so far as the animal enters into relationship with his surroundings he is alive; when all commerce between him and his surroundings ceases, he dies. In order to live he has to adapt himself to the shifting conditions with which he is surrounded. If there is no food where he is he has to move about until he finds some; if a beast of prey comes along he has to decamp, unless he is stronger than the beast of prey—in which case the question may be settled in another way.

Precisely the same is true of man. Man's life, too, consists of adjustment to environment. It does not matter whether we say that his mind has to get into that sort of relationship with the world of fact which we call knowledge, or that he has to adjust his body to his physical and social surroundings just as an ordinary animal does. In the end it comes to the same thing. Biologically regarded, consciousness is merely a means of enabling him to carry out this adjustment more effectively. Primitive man, for example, had to contend with all sorts of difficulties and dangers in his struggle for life in competition with the stronger and fiercer animals that shared this goodly earth with him. The man who could pit his cunning against their strength, the man who could circumvent his enemies, the man who could reason, had a much better chance of surviving than the fool who had not sufficient wit to keep himself out of danger. The fool paid for his folly by extinction. Thus men endowed with the higher faculties were able to steal a march over their stupider comrades. Those days of struggle and strife are over; but not entirely so. Man still has to struggle in order to obtain the bare means of existence; but all his energies are not absorbed in this struggle. And some there are who toil not, neither do they spin.

Let us look a little more closely at this word environment. What does it mean? The child and the dog live in the same house. They are surrounded by precisely the same sights and sounds. They hear the same people talk; they see the same household duties carried on. And yet what a difference! What is an effective part of the environment to one is a non-

effective part to the other. The pictures on the wall, the words uttered by his parents, become fraught with meaning to the child ; but to the dog they are meaningless. The smells that issue from the dustbin are of more interest to the dog than the words that issue from the mouth of his master. The actual environment is the same in each case ; but while the dog enters into relationship with a very small and limited part of that environment, the child enters into relationship with an ever widening circle of things, both natural and spiritual ; while the dog is concerned almost exclusively with those material things which serve to keep him alive, the child concerns himself with a host of things which have no bearing at all upon his mere bodily subsistence ; while the dog is merely interested in things actually present in time and space, the child is interested in things that happened " once upon a time," and in a far-off land. The dog is educated to the end of his tether in the course of a few months ; the child does not necessarily reach the end of his tether at the close of a long and strenuous life. What makes the difference in the two ? It is entirely a matter of instinct, of innate tendencies, of impulses, of a natural stretching out of the mind towards the environment—call it what you will. Without this spontaneous outstretching of the mind nothing can be done ; with it everything is possible.

The school curriculum represents a conscious attempt to provide the child with a suitable environment. It is not sufficient to present an environment, however rich and varied it may be : we must present a *suitable* environment ; we must present an environment which will arouse his natural impulses—an environment to

which he will respond. It is no use offering his mind any sort of food : we must offer him food for which he is hungry. If he has no appetite for it, it is an indication that he has not the power to digest it. As Whistler has pointed out, the policeman in the National Galleries, even though he has spent his lifetime among pictures, is not necessarily an art critic. "Nature plays at dominoes with you," as Holmes puts it ; "you must match her piece, or she will never give it up to you."

For knowledge to arise in the child's mind two things are necessary. First there must be an environment, and secondly a natural impulse to enter into relationship with that environment. These two must be present. When both are present, knowledge is born. Without the suitable environment, the impulse, if it exists at all, is a mere impotent stretching forth into the void ; without the impulse the environment is so much dead, inert material. A child is interested in everything that satisfies any of his natural instincts, and anything he is interested in may be described as possessing "value" for him. Food and water, bird and beast, wind and rain and sunshine, his comrades and his kin, all have value for the child. They are to him the real things in the world, the things that count, the things that stir his blood and move him to action. When he grows older there are other things that interest and excite him : cycling records, by-elections, votes for women, and many other activities of the larger world. But the thing must be of value to him if he is to gain any effective knowledge concerning it.

There is another kind of value that things have for a child, and that is a derivative value. For instance : to a very young child a penny is intrinsically valuable.

It appeals to his primary instinct to manipulate and play with things. It is a round thing which will roll, and a flat thing which will remain where it is fixed. It is interesting and valuable in itself. But when he discovers that he can purchase apples and lollipops with it, it acquires a derivative value which is quite distinct from its primary value and tends to supplant it. Later on in life this derivative value becomes to him its only value. Adults do not carry pennies about in their pockets because they are pretty, but because with them they can purchase newspapers, tobacco and other things. The penny was at first an end in itself: it then became a means to some other end. Its first value was a real value; its second value was a derived value.

Precisely the same thing happens with words. The words a young child first utters are probably interesting to him as mere sound: he loves making the sounds and hearing his own voice. It satisfies his instinct to produce things. He finds joy in mere jabbering. The words are, in fact, of intrinsic value to him. But he soon learns that they are serviceable in expressing his needs and wishes, in vivifying his percepts and holding together his ideas; and his old interest in words is soon overwhelmed by his new interest. Their value, from being intrinsic, has become derivative. From being ends they have become means.

We have now arrived at a clear and definite distinction between things that are of primary value to the child and things that are of derivative value; things that make a direct appeal to him and things that make an indirect appeal; things in which his interest is immediate and things in which his interest is derived; things that

are ends in themselves and things that are merely means to ends ; things that are real and things that are only symbols of the real. This distinction affords a criterion by which to examine and criticise the kind of work done in our schools.

To begin with, the handwork is of primary value. Of that there can be no question. The child is brought into direct contact with the material world ; he exercises his natural powers in gaining control over his immediate environment ; he is adapting means to ends ; he is doing something which is intrinsically interesting to him ; he is gaining real first-hand knowledge ; he is developing the motor areas of his brain ; finally, he is exercising those higher centres of the brain which are rendered active when he thinks out how he can overcome such difficulties as his work presents. There is not the slightest doubt about its enormous value. It is the natural method of learning by doing ; it is the method by which the human race has educated itself from a state of barbarism to a state of civilisation. All the progress made by the human race in intelligence has taken place *pari passu* with its mastery over material things.

Nature study is another subject of primary value. I use the term Nature study here in a very wide sense. Broadly speaking, it comprises that part of the child's environment to which he is most responsive. It includes his mother, his companions, and his food. The interest a child takes in his natural surroundings is deep-seated and of remote heritage. The time during which mankind has lived in towns, compared with the countless ages spent among the hills and forests face to face with wild nature, is ridiculously small. The instinct born

of racial experience appears strong in the child. He is not indifferent to the living things among which his remote ancestors dwelt. He either loves them or dreads them. The wind and the rain, the magic of the woodland, the world of fur fin and feather appeal to him as the world of brick and mortar never did appeal. Nature study is, in fact, not a fad, as I heard it called the other day, but an essential part of a well-reasoned educational creed.

We have already touched upon speech. When we come to examine it a little more closely we get to realise that it is quite a unique factor in promoting the development of the child's mind. To begin with, its primary value never quite vanishes. A child delights in jingling rhymes and in the mere sound of words. A schoolboy revels in such curiosities as this: "How much wood would a wood-chuck chuck if a wood-chuck could chuck wood?" The reply is, "As much wood as a wood-chuck would chuck if a wood-chuck could chuck wood."

If he advances to a secondary school and takes up Greek it costs him no effort to learn

Πολλὰ δ'ἄναντα κάταντα πάραντά τε δόχμιά τ' ἦλθον.

In the second place a child shows a curious inability to distinguish between the name and the thing. To him they are identical, so that the value of the one is almost wholly transferred to the other. A child cannot think of the word apple without thinking of the thing apple as well; nor can he think of the thing apple without also thinking either of the word apple, or of some equivalent representative. It is true that the word is a mere conventional symbol, but it is a symbol which does its work so well that the mind normally

refuses to dwell upon the symbol and rushes immediately to the reality symbolised. It is true that language is only an instrument, but it is an instrument that is so necessary to the child in satisfying its most pressing needs, that we cannot prevent him from acquiring its use. Whether a child goes to school or not he will learn to talk. The educational value of language consists not merely in the fact that the child is thereby able to communicate his thoughts to others, but that it is a means of thought itself—a means by which he can make his own ideas clear to himself. "There is a time," says a recent writer, "in a child's life when if he is to think at all, he must think aloud." Oral composition should be taken in every class in the school, for it is of equal importance with handwork as a means of brain development. It is another form of motor activity, and as in the case of educational handwork it is motor activity plus something else: and that something else is in itself of paramount importance. Let the children talk, as far as is compatible with class teaching—let them talk about what they are doing, about their homes, their books, and about anything, in fact, that interests them.

Story-telling should form part of the curriculum of all schools both infants' and senior. In the childhood of the race story-telling was, with the exception of the war song, the only form of literature. The love of stories is a common heritage of all children from the youngest to the oldest, from the stupidest to the cleverest. Nor is it to be regarded as merely recreative. The emotional expansion that comes with hearing a good story is not without effect upon the intellectual growth of the child. But if it is told to a class of the bigger

boys let it be a thrilling tale with plenty of adventure in it. The namby-pamby sort of story about the sweet little flower that falls in love with the dear little dewdrop and exchanges with it the vapidest of sentiments, makes a very ineffectual appeal to the full-blooded boy one often finds in our schools. He prefers a story with a good sprinkling of wholesome murders. The more dragons are slain, the more giants are beheaded, the more captives are made to walk the plank in the pirate ship, the more the deck of the said ship welters in gore, the more delighted is the boy, provided his nerves are sound. It satisfies some of the instincts of the savage left in his nature. Whether this love for tales of bloodshed should be discouraged, or whether it is but a passing phase which should be allowed some innocent vent, is a matter open to question ; but there is, to my thinking, no question at all as to the unsuitability of some of the Nature study stories to the burning interests of that active little lad who is all impatience to be out wading in the duckpond or chasing butterflies in the field, but has to sit still and listen to a tedious teacher talking platitudes about buttercups and daisies. For the sake of a bad correlation an opportunity for a good story is missed. And a good story does more than satisfy a mere craving for excitement : it always brings about an expansion of the self. The boy always identifies himself with the hero of the tale. The intrepid lad who climbs the beanstalk is himself. It is he who in the seclusion of the oven hears the terrible words : " Fe, fi, fo, fum," and it is he who by his valour and resource outwits and ultimately slays the monster who spoke those words. Every little down-trodden girl in the London slums is herself Cinderella. The possibility

of the fairy godmother and the slipper and the prince is *her* possibility. The ultimate triumph of right over wrong, of love over hate, is to be exemplified in her own case. Story-telling is the one instance in which merely talking to children is really effective.

Singing is another form of speech. It is speech with a super-added beauty of sound. The spontaneity and naturalness of song need not be dwelt upon as it is obviously common to man and bird. We cannot all sing well; but we can all sing.

What shall we say about drawing? We note that a young child draws spontaneously: no artificial inducement is necessary to make him use the pencil or the brush. He learns to draw as he learns to speak—by mere imitation of his elders. It satisfies his instinct to make things—to produce some real tangible result. It is one of the most natural means by which he can objectify his mental images. It is motor training of the best kind. It is one of the many modes of response to stimulation in the visual field. A child takes to drawing as a duck takes to water. We find no race of savages so degraded that they have not some form of pictorial art, and skill in this art may serve as a rough criterion of the grade of their intelligence. The cave-dwellers of the pre-Glacial epoch scratched with flint upon the tusks of the mammoths they had slain rude drawings which have recently been discovered in the bone caves of France, and which serve as clear testimony of the intelligence of our remote ancestors.

The sketches made by the savage and the child can scarcely be regarded as symbols of other things; they are those other things as far as he apprehends them, or is

able to express his ideas of them. This kind of drawing which is primitive and vital, which corresponds to something previously existent in the child's mind, must be clearly distinguished from the formal drawing of the old South Kensington pattern—drawing from copies which represent nothing that is in the heavens above or the earth beneath or the waters under the earth. Artificial in themselves, they become doubly artificial when copied by the child. The latter is a training in technique only; the former is a training in technique and more; and in that "more" is the very soul and secret of early education—instinctive interest. Drawing and painting from real objects are of primary value; the drawing of symmetrical design, of derivative value.

Arithmetic, again, is another subject which may or may not be of primary interest to the child. So long as it deals with objects and processes within the child's range of experience it is primary. It is of interest to a child, for instance, to know that it is better to have six apples than five, and that he will have more left when two are stolen than when three are stolen. But when he is asked to invest £35,000 in the 3½ per cents. at 97 he is driven not only beyond his actual experience but also beyond his probable experience. When he endeavours to find the value of $\frac{5}{6}$ of $\frac{2}{3}$ of ·196 he is working outside his familiar circle of thought, and no one will contend that in his effort to grapple with the problem he is likely to show marked signs of enthusiasm. All arithmetic that deals with concrete things within the child's experience, all practical arithmetic, all arithmetic that can be worked without the use of arbitrary symbols such as the common digits, is primary. The rest is

derivative. It must be confessed that the bulk of our school arithmetic falls into the second group.

It will be noticed that the various subjects as we take them in order are becoming increasingly artificial—are getting further and further from the starting-point of spontaneous interest.

How shall we classify the important subject of reading? Is the child naturally attracted to those conventional symbols for the sounds of our common speech which we call letters? Their intrinsic value is almost nil. A letter of the alphabet regarded merely as a drawing is entirely devoid of interest. It resembles nothing that the child has previously experienced. It is a pure symbol and nothing else. It is a means to an end: and therefore its value is necessarily derivative. Reading is not in itself knowledge: it is a mere instrument of knowledge. How then can we justify the importance attached to this subject? The answer is that although in itself it is unimportant, the end to which it is the means is of supreme importance. It is a means of enlarging the child's mental horizon; it makes him a possible spectator of all recorded time; it enables him to escape from the narrow environment in which his lot had fallen.

Its educational value is enormous; but at the same time it is derivative. The same may be said of writing.

We are now in a position to arrange the subjects of instruction in the order of their value in the sense indicated above, starting with the purely primary and ending with the purely derivative.

1. Physical activities, including manual occupations.
2. Nature study in its very broadest sense.

3. Oral speech, including story-telling and music.
4. Drawing, which is only a particular form of No. 1 (Motor Training), but which, on account of its importance, deserves special treatment.
5. Arithmetic.
6. Reading.
7. Writing and Spelling.

I do not mean that this is the arrangement of the subjects in the order of their importance from the point of view of the school, nor is it the order of importance from the point of view of the adult; but it *is* what I conceive to be the order of importance from the point of view of the development of knowledge in the child's mind.

One important thing to remember is that a child's education, in the broad sense of the word, is largely advanced before he reaches school at all; and the main object of the school is to supplement the education the child gets out of school. Take the first subject on my list: motor training—the training got from physical activities. It has been said, and wisely said that movements are our best educators. At any rate, they are our earliest educators. This kind of education begins at birth: so does that first-hand knowledge of our surroundings gained through the senses, which I have roughly termed Nature study. That is why I have placed them first. They come first in order of time. They are the foundations of a child's mental fabric: without them nothing else is possible. If the motor and sensory areas of a child's brain are undeveloped, to try to teach him the three R's is as futile as trying to teach a weathercock to crow. Without the foundations of a building the superstructure is impossible

Next on the list come speech and music. At the age of eighteen months or two years the child begins to speak, and before he enters school he has mastered the mother tongue sufficiently to express his needs, his wants, and his simple ideas. Most children, too, spontaneously take to drawing, generally in imitation of their elders. It is a form of self-expression more natural even than speech, as it more closely resembles reality.

Since ordinary everyday life, therefore, makes provision for training in these four subjects—handwork, Nature study, speech, and drawing—they were until quite recent years entirely omitted from the school syllabus. The classics and mathematics were considered sufficient in a secondary school and the three R's in an elementary school. Only those subjects were taught in school which could not conveniently be learnt in the home. This practice is now recognised—or at least should be recognised—as being based upon an erroneous and dangerous doctrine. The doctrine assumes that the child has received sufficient training in the fundamental disciplines to benefit by formal instruction in the use of those tools of knowledge which we call the three R's ; that the child *has* the *real* knowledge and need now only become acquainted with the *symbols* of knowledge. The assumption is that life does the ground-work : it need not be done by the school as well. It was forgotten, however, that although life does the work it does it very imperfectly, and that it is the duty of the school to supplement the educative influences at work outside the school. It was further forgotten, that all children are not equally educable ; that while these outside educational forces do their

work rapidly and well with some children, they do it very slowly and very badly with other children. The business of the teacher in this case is to complete in the school what is imperfectly done in the home. In no case is the informal home training in what I regard as the fundamentals of education so adequate as to justify us in excluding these subjects from the curriculum of the school.

Their inclusion in a school for infants or for mentally defectives is vital and imperative. The intelligence of the child is first roused into activity by the real things of the universe ; and these must do their work effectively before the symbols of knowledge can have any force of appeal. The sequence of the development of interests in the child's mind must be observed. We can no more reverse the order than we can reverse the order of bud, flower, and fruit. Nature has fixed them for us. If we disregard her laws we do so at our peril.

This fact has long been recognised by all earnest thinkers on the subject, and the splendid system of special schools organised by certain education authorities is a tangible sign of this recognition. As a cure for dulness they rely upon subjects which are of primary value to the child—manual occupations mainly—and not upon those which are of secondary and adventitious value, such as reading and spelling.

At this point an important practical problem presents itself. How much time should be devoted to the first class of studies—those possessing real value—and how much to the second—those possessing derived value ?

I will merely lay down this general principle : the younger and the stupider the child the larger should

be the proportion of time devoted to the study of real subjects.

You will note that I have omitted all mention of geography, history, and grammar.

Grammar may be easily disposed of. Except as an aid to composition it has no place in the elementary school.

Geography is not specifically mentioned because its subject-matter is covered by my list. It consists in fact, of nothing but Nature study and handwork, the latter term including modelling, drawing, and map-making. It is begun as purely observational and expressional work—looking at samples of geographical data, reasoning about them, and expressing them in various forms. It is continued beyond the limits of first-hand experience by applying the principles already learnt to new facts supplied by pictures, maps, books, and descriptive speech.

Similar reasons account for the omission of history. As taught in our elementary schools, history is story-telling, pure and simple. Scientific history, however, while using story-telling as one of its methods, essentially consists in an attempt to explain the present in the light of the past. It aims at an analysis of present social conditions by an examination of how those conditions came into existence. Of history in this sense we find but little trace in our schools. In some of the American schools that have come under the influence of Dr. Dewey an attempt has been made to re-construct the earlier stages of the development of the race by means of a course of handwork. The children are led to rediscover such epoch-making inventions as cooking, weaving, smelting and printing. They re-live the lives of pre-

historic savages, re-think their thoughts, and re-conquer their difficulties. A similar course was tried last year with much success in the L.C.C. Open Air Schools. Taken in this way, history is seen to resolve itself into story-telling and handwork.

Having thus investigated the nature of the elementary school curriculum, have we any lingering doubts as to which subjects are fundamental? There was no trace of dubiety in the opinion of the schoolmaster of former days. His verdict was emphatically in favour of the three R's. Even nowadays we constantly hear the three R's referred to as the fundamentals of education; and a head teacher, even in an infants' school, is far more sensitive to criticism of these three subjects than to criticism of any other school subject. The belief is that the three R's constitute the solid fabric of school instruction: the rest is ornament.

Now there are two things that can be said of these views. The first is that they are false, and the second is that they are harmful. In no profitable sense can the three R's be regarded as fundamental. They do not belong to the foundation: they belong to the superstructure. They are not processes upon which the earlier activities of the mind are dependent: they are themselves dependent on those earlier activities. First things in education they emphatically are not: they can only be pursued with profit after other things have been accomplished. In maintaining that the three R's are not fundamental it is not contended that they are not important. They *are* important because they are the keys by which the child can escape from the narrow environment of the illiterate. It has been well said that a tool is a mere extension of the human arm.

A walking-stick, for instance, is an elongated finger. A hammer is an iron fist at the end of a wooden arm. They enable the user to gain easy and effective control of a wider environment. They magnify his natural powers. It is important to remember, however, that they presuppose the human arm, and are absolutely useless without it. In the same way the three R's may be regarded as tools by which the field of operation of our natural powers may be indefinitely extended. In writing we talk with the pen, and can command a larger audience than any building in the world can hold: but it presupposes the ability to talk; when we read we listen with the eye to voices some of which have long been silent: but we have elsewhere acquired the ability to understand what we hear. Arithmetic enables us, by the use of written symbols, to extend our powers of calculation; but the initial power to calculate is postulated all along. So, while recognising the importance of the three R's as instrumental subjects, we deny their importance as substantive subjects. For importance, it must be remembered, is purely relative to purpose. For the gratification of my personal vanity it is important that my nose should not exceed three inches in length; but for purposes of national defence it is of no importance whatever. For the expansion of personal knowledge beyond the limits of first-hand experience the three R's are vitally important: but for the acquiring of the necessary minimum of first-hand knowledge, and for generating the desire to extend that minimum they are of no importance at all. The desire to use the three R's is born of something other than the three R's themselves.

How can we account for the marvellous change

that has taken place in the character of the infants' school during the last twenty years? It is unquestionably due to the insight of a few choice spirits into the true nature of the various subjects of instruction. In the old-fashioned infants' school (a type of school which is by no means extinct) the three R's formed the staple of the curriculum throughout. It was considered a place where the children were prepared for the formal work of the senior department. The idea of preparation will be readily admitted. All education is—in part at least—a preparation. But there are several ways of preparing. You can prepare for your dinner by going out for a walk and getting up an appetite; or you can prepare for it by taking a little of the dinner beforehand to give your stomach preliminary practice in the process of digestion. The former is a good preparation, the latter a bad; and it was the bad preparation that was adopted in the old type of infants' school. But the evil did not end here; it invaded the senior departments, where the three R's were regarded as the be-all and end-all of school life. Some of the pupils were apparently impervious to this mode of instruction. They were regarded as stupid. There was a gradual accumulation of them at the lower end of the school. The dullest of these dull children were generally put together in one class, and the dullest teacher in the school was put to teach them by the dullest method yet invented—the method of grind. They were children to whom the three R's had proved to be indigestible, and they were treated for dyspepsia by the very diet which had caused the complaint. It is only of recent years that educationists have realised that the three R's never did and never can cure dulness. The ill

effects of the older system were not confined to the stupid boy; the clever boy and the ordinary boy suffered as well. I think you will agree with me that the only real test of the value of the education a boy has received in school is the kind of life he leads after leaving school; and the kind of life he leads after leaving school is determined not by what he knows, but by what he is interested in. And the three R's cannot evoke interest. They are in themselves deadly dull, and are only made tolerable when regarded as paths that lead out into the pleasant fields of literature, art, and science.

Let me recapitulate the main line of argument in this chapter. In order to investigate the principles guiding school work it is best to take one definite point of view. That point of view is supplied by the modern theory of evolution—the notion that education is adjustment to environment. This adjustment is brought about by means of natural tendencies in the child which form points of relationship with the external world. These natural tendencies or interests give "value" to the various items which constitute the environment—value, that is, as far as the child is concerned. These values supply motives for the child's mental and physical activities. The younger and more backward the child the nearer must be the motive—*i.e.*, the more immediate must be the value: the older and more advanced children are capable of being influenced by remoter motives. Applying these principles to the curriculum we find that, broadly speaking, handwork, speech, and Nature study represent the subjects of immediate value, and the three R's the subjects of remote value. It is the duty of the teacher to adapt

and proportion these two classes of school subjects to the various needs of his scholars.

It must be fully recognised that the three R's are not fundamental, that they are, in fact, of no educational value until a foundation of other knowledge is laid, and that the degree of their value depends upon the extent and security of that foundation.

FORMAL GRAMMAR.

FORMAL English Grammar is at present under a cloud. It has been asked to show cause why it should not be banished from the select and exclusive circle of subjects taught in the primary schools. The theorist jeers at it: the practical schoolmaster looks askance at it. Already it has been deleted from the time table of a number of our schools, and in a still larger number it has taken a milk-and-water form popularly known as Langauge Lessons. Even in secondary schools its value has been called into question. The fact that a foreign tongue is taught in the school is regarded by some as insufficient ground for the retention of a systematic course of English Grammar, for it is contended that the foreign tongue should, like the mother tongue, be a direct acquisition. These views are not universally held, but the fact that they are held at all indicates a significant change in professional opinion. From time immemorial Grammar in some form or other has occupied an honoured position in our schools. What is the meaning of its sudden fall? What is wrong with Formal Grammar? Is it bad in itself, or is it a good subject badly taught, or is it a good subject well taught but unsuited for young children? Those of us who have spent many a pleasant hour—pleasant at least in retrospect—trying to get our pupils to think about the language they use (and sometimes succeeding) still retain a lingering fondness for the subject, and are by no means disposed to desert an old love for the mere pleasure of being in the fashion.

Surely much may be said in its favour. Even if it is of no great service in the way of helping us to speak correctly, it may at least be regarded as an important branch of scientific study. It deals with phenomena with which we are daily and hourly brought into contact—the phenomena of language. The subject lends itself admirably to study in the class-room. The concrete specimens to be examined—the words and sentences we use in everyday speech—are plentiful and very cheap. The teacher need go to no trouble or expense in securing these specimens: each child has a plentiful store in his own head. The lesson may be made a valuable exercise in logic, both inductive and deductive. The children may by the examination of familiar instances be led to make their own generalisations. They may pass freely from the particular to the universal, and from the universal back again to the particular. The teacher may, in fact, treat language study in precisely the same way as he treats Nature Study and Elementary Science. The phenomena are in each case equally familiar, and the methods of study may be rendered equally logical and scientific.

Or the subject may be treated deductively.* The teacher may start in the text-book method with a rule or definition. The rule is applied by the class to particular instances. It is an exercise in deduction—a syllogism in "Barbara." All names are nouns; John is a name; therefore John is a noun. Not a very difficult intellectual feat, you will say. True, but a typical case, such as it is, of simple deductive reasoning.

So, whichever way the subject is dealt with, it at least affords practice in logical thinking. And if it

* It must not be inferred that I regard this as a good method.

is contended that logic has no place in the Primary School, the plea lacks consistency. Arithmetic is logic as applied to numbers. Science is logic as applied to natural phenomena ; for we not only observe the phenomena : we reason about what we observe. Yet no one has been found rash enough to suggest that these subjects, in view of the demands they make upon the child's reason, should be removed from the curriculum of the Elementary School.

There are two grounds upon which we select our subjects of instruction. First, that they serve some of the larger purposes of life, and secondly, that they afford mental discipline. The first ground practically includes the second ; for having selected a subject on the first ground, we can so teach it as to supply the second. The discipline is mainly a matter of method. Even if we regard these two criteria as independent, Grammar can be shown to satisfy both. Clearness and accuracy of expression are desirable in all departments of intellectual activity, and a knowledge of Grammar is necessary to achieve this with scientific certainty. We must not only speak correctly, but know that we speak correctly, and not only know it but be able to justify it to others. Without Grammar this is impossible. Even if we admit that a second language—either classical or modern—should be attacked by the direct method, we may still maintain that a knowledge of English Grammar is at least an aid in the acquisition of that second language. It economises labour. It helps us a little to speak our mother tongue correctly; it helps us still more to speak a foreign tongue correctly ; it helps us most of all by giving us scientific standards by which to test the accuracy of our speech

and to rid it of obscurities. Grammar unquestionably serves a purpose in life which can in no way be regarded as unimportant.

That it affords a valuable mental training will, after what has been said of its logical nature, be readily conceded.

Where, then, is its vulnerable point? I am afraid, dear reader, that if we look closely we shall find lurking underneath the previous argument a very old fallacy—the fallacy of regarding the child as a little adult, of assuming that what is true of an old child is equally true of a young child. We see two definite points of attack. It may be urged first that children under a certain age (say thirteen) find the subject uncongenial and uninteresting, and secondly, that they are incapable of understanding it. First it is too dry, secondly it is too hard. The first charge may be dismissed with the remark that it is at least as interesting as those complex operations with abstract numbers which young children do not find intolerably tedious. Moreover, an enthusiastic teacher can make almost anything interesting. The second charge, which is not entirely disconnected with the first, is more difficult to refute. It is here, in fact, that, in my opinion, the case for Formal Grammar breaks down. For that it does present peculiar difficulties to the immature mind there is no lack of evidence. It is true that children of eleven and twelve years of age can be got to parse and analyse with surprising facility. But a simple test of an unusual nature reveals the peculiar detachment of the mental machinery by which this is done. Very frequently have I asked children in the sixth and seventh standards, who have received systematic instruction in Grammar, if they

can explain what is wrong with the sentence: "Dick came home with I." They never, of course, have any difficulty in detecting the error, but the reasons they give, though cogent enough in their way, have nothing to do with Grammar. "It sounds wrong;" or "We don't say it like that;" or everybody says, "Dick came home with *me*;" and so forth. When asked to give grammatical reasons they make wild and desperate shots. "The tense is wrong;" "The first person is used instead of the third;" "'I' is active voice and it ought to be passive." I have recently been setting a written test to a large number of children in a variety of schools where formal Grammar is taught. The first question asked was: Why is the following sentence wrong: "He likes me and I like he?" Some of the replies deserve quotation:—

"Because instead of using the past tense 'him,' 'he,' the past participle, is used, and the past tense is always used with verbs."

"It is wrong to use a preposition instead of a personal pronoun; plain common sense will tell you that, it should be: He likes me and I like him."

"The first sentence is wrong because the past of 'he' is 'him.'"

"It is wrong because if you turn it round you will find it comes 'I like *him* and he likes me.' 'Me' is one sort of pronoun, and 'he' is another sort of pronoun."

These answers were given by boys in the top class of a school where the general work is distinctly good. Three hours per week are devoted to French, and the results in this subject are highly creditable.

Generally speaking, I found that Standard V. children

could not answer this question at all, and that only a very small proportion of Standard VI. children could. In Standard VII. nearly all the answers were correct in some schools, while in others not a single correct answer was given.

Another question set at this written test was as follows: Which is correct: "If it rains to-morrow I will stay at home," or "If it rain to-morrow I will stay at home?" Give reasons. In one school only—a school where the top class is particularly well taught—was there any evidence that the pupils had an intelligent notion of mood. Even here, however, many of the answers had this curious and gratuitous addendum: "In the subjunctive mood the verb is always in the plural."

The boys already quoted attacked this question most gallantly:—

"'If it rain to-morrow I will stay at home' is more correct. We think of rain as one thing, but if we were thinking of separate drops of rain we would use rains."

"'If it rains' is correct because 'rains' is singular and one is not talking about different kinds of rain but the ordinary rain."

"'If it rains to-morrow' is a commoner expression than 'if it rain to-morrow.' When you say 'If it rain to-morrow' you must be thinking of only one rain, but it may rain on and off. Therefore 'rains' is correct."

"'If it rain to-morrow I will stay at home.' This is the correct sentence because rain *is* plural, and if you were to say 'rains' you would be using the plural plural."

"Rains is right because rain is a noun, but rains is a verb."

"The sentence 'If it rains to-morrow,' etc., is correct. The sentence is uncertain, and 'rains' is uncertain, while the other sentence is uncertain, but 'rain' in it means that it is certain to rain, so there is a mixture of certain and uncertain."

A born dialectician, this lad! with an eye for contradictories worthy of Hegel.

A few more answers from another school: "The first sentence is correct because it seems more natural to say 'rains' than 'rain' in this particular sentence."

"No. 1 sentence is correct (I cannot say why it is correct, only by its pronunciation)."

"Rain is right because it cannot rains to-morrow."

"The first is right because rains is a more fitted word than rain. Rain is crued and awkward."

A few other questions were put to test the extent to which the children were able to distinguish between words and things.

1. Is there any difference between sex and gender? If so, what?

2. "An adjective is a word that describes a noun." Is this a correct definition?

The commonest reply to the first question was that there were only two sexes but three (or four) genders. Several said that gender referred to persons and sex to animals. One said that the only difference between sex and gender was in the spelling. Quite a large proportion asserted that there was no difference at all between them.

Very rarely indeed was an adequate reply given to the second question. In some schools not a single

answer was obtained which could be considered in any way satisfactory.

A specimen answer :

" ' An adjective is a word that describes a roun.' This is correct sometimes, as in ' A black sheep with pink eyes.' This describes the sheep as having pink eyes and as being black, while you might say, ' Clean the blackboard.' Now this is incorrect, because the board is not black but grey."

Finally, one question was set to ascertain whether the pupils understood the nature of a grammatical rule :—

What reasons have we for saying that a preposition governs a noun or pronoun in the objective case ?

This brought no satisfactory response. Two curious answers may be quoted :—" A preposition is one of the most important words in a sentence—*e.g.*, The boy fell into the water. If the preposition ' into ' was not there the sentence would sound ridiculous."

" I have never been told the answer to this question, and it has never occurred to me to ask it."

The ingenuity displayed by these delightful boys amply compensates for their poverty of Grammar ; but the results point to a manifest wastage in teaching energy. Until a child reaches the seventh standard, which he normally does at the age of thirteen, the bulk of the effort spent in teaching him Grammar is unproductive. Where it seems to be successful, the success will not bear investigation. The wide diversity of results in Standard VII. points to a wide diversity in teaching methods. Many teach it well, but more teach it badly. After making all due allowance for bad

teaching, my experience forces me to the conclusion that grammar as a systematic science is a study unsuited for children under thirteen years of age. One very curious result of my enquiries is that the study of another language, such as French or German, seems to make no appreciable difference in the child's capacity to grasp grammatical relations.

Medical opinion fully supports this general view. Dr. Oppenheim, for instance, in his book on the Development of the Child, says : " Grammar, which is highly abstract, has no place in either elementary or so-called grammar schools. It should be confined to high schools or the secondary schools, where the mental development of the students approaches the adult form."

It would be well to search for an explanation of the alleged unsuitability more adequate than that suggested by Dr. Oppenheim, viz., the abstract nature of the subject. The real secret of the difficulty the subject presents to young students is, I think, to be found in the peculiar complexity of the subject-matter. Grammar deals with words and sentences. Yet not exclusively so. For if it did it would be a comparatively simple science. Words are simply different arrangements of a strictly limited number of sounds, if spoken ; or of letters, if written ; and these sound or letters may quite easily be examined, compared and classified. The relationships between the words are few, and between the sentences (regarded as a mere aggregation of words) fewer still. One word, for instance, may be twice as long as another word, or may come before or after it in the sentence. These are relationships between words as words ; and with these relationships Grammar has nothing whatever to do. It takes cognisance of other

things besides words : it deals with the meanings of the words—the things of which the words are the symbols. At this point we meet with an ambiguity. Is the word the symbol of the concept or of the thing ? The word "ship," for instance—is it the name of a notion in the mind of the thinker, or is it the name of the actual thing that floats on the water ? The only reasonable reply seems to be that it is the name of both. Language has, in fact, both a subjective and an objective reference : it refers to a psychological fact and at the same time possibly to a physical fact. In dealing with grammatical relations we sometimes have to fix our minds on the ideas, sometimes on the words, and sometimes on the things. There is a constant oscillation of the attention between these three series. A sentence, for instance, is sometimes defined as a complete thought (mental world) expressed in words (verbal world), and an adjective as a word (verbal world) used to describe a thing (objective world). This shifting of the attention from one category to another, preserving at the same time its centre of gravity within the category of words, is a balancing feat which the experienced adult finds none too easy. The child finds it very difficult. To begin with, one of the three series—the mental series—is never to the ordinary child an object of thought. He thinks about things : he never thinks about thinking. Even the second series—the word series—which is from the grammatical point of view the most important of the three, is but rarely a matter of interest to him. He does not, as a rule, think about words : he thinks about the things symbolised by the words. This is, of course, equally true of the adult. In the normal use of language the words enter the focus of consciousness for a period infinitesimally short—just

long enough, in fact, to deliver up their meaning. This done, they immediately slip back into the margin while the meaning lingers in the focus. They stand in the wings while their contents disport before the footlights. It is thus quite unnatural for a child to think of words as words. To him they serve as a more or less transparent film through which he looks at the realities beyond. If he does begin to think about the word, its meaning so closely clings to it that he finds the greatest difficulty in holding the two things apart. This is illustrated by a story told of a well-known inspector who was questioning a class of boys in Grammar.

Inspector: If you were to say to me: "You was here yesterday," would that be right?

Chorus of Boys: No, sir!

Inspector (delighted): And why not?

Boys: Please, sir, because you wasn't.

That this threefold nature of the subject-matter is a real source of perplexity is shown by the way in which grammarians themselves get confused. Dr. Morris, for example, defines a sentence as a complete *thought* put into words, and Mr. Nesfield as a combination of *words* that makes a complete sense. Is a sentence a thought or is it a string of words? If it is a compound of the two, which is the essential constituent? Do the words form the body of the sentence and the meaning its soul? To use the fantastic words of the schoolmaster in Love's Labour Lost, is the sentence "begot in the ventricle of memory, nourished in the womb of pia mater, and delivered upon the mellowing of occasion?" And if anyone should contend that it does not matter whether the baby sentence is considered as a body animated by a soul, or as a soul animating a body, my

reply would be that for each specific science a specific point of view should be taken. To the Psychologist I am a mind, to the Physiologist a body, to the Moralist a will, to the Political Economist an industrial unit, and to the Chancellor of the Exchequer a victim for taxation. So to the logician the essence of the sentence consists in the judgment—the thought; but to the grammarian, if a consistent point of view is to be maintained, the sentence can be none other than the series of words. That being so, what becomes of the definition of a conjunction as a word that joins sentences together? A disjunctive conjunction is defined by Dr. Morell and others as one which, while it joins two sentences together, disconnects their meanings. Here we have a recognition of the dual nature of the sentence and an assertion that a conjunction joins on the one plane and disjoins on the other. But the joining function of a conjunction does not consist in effecting a mechanical adhesion of words, but rather in indicating that two facts or assertions have to be held together in the mind and considered in a certain relation. The word "but," for instance, calls attention to the contrast between two assertions, "because" indicates a causal relationship and so on. So, although a conjunction is in itself a word, if we wish to define its function we must at once get out of the region of words into the region of ideas or of facts.

To take another instance, Dr. Morris defines case thus: "Case is that form of the noun (or pronoun) which shows its relation to some other word in the sentence." Here words are confused with things. Mr. Nesfield, in his English Grammar, which is one of the best text-books on the market, repeats the blunder in an

exaggerated form. "The relation," he says, "in which a noun stands to some other word, or the change of form (if any) by which this relation is indicated, is called its case." Here there are three things under consideration :

(*a*) A relation between words.

(*b*) A relation between things.

(*c*) A change in the form of a word to indicate (*a*) or (*b*).

To begin with, Mr. Nesfield is evidently not certain in his own mind whether case is a relation or whether it is a verbal modification which indicates that relation. In the second place he has hit upon the wrong relation. He selected (*a*) when he should have selected (*b*). There is a real dilemma involved. If one defines case as a change in the form of certain words then all nouns and some pronouns are immediately deprived of the privilege of having objective cases. The contention that the word "corner" in the sentence "Little Jack Horner sat in a corner" is in the objective case because if "corner" had a case termination it would take the objective form, is as though one should say : "That dog has no tail ; but if it had a tail it would be a curly one. We must therefore refer to him as the dog with the curly tail." To say that it once had a curly tail, which has disappeared, is beside the point. The child has to judge on the evidence within his range—the evidence of the mother tongue as he knows it—and historical considerations are outside the evidence. If, on the other hand, one takes refuge in a theory of relationship pure and simple, one gets outside the region of Grammar, which primarily deals with words and is only concerned with meanings in so far as they bear

upon the forms or arrangements of these words. So the dilemma is a real one. Mr. Nesfield has seen the dilemma, but has somehow managed to get himself impaled on the wrong horns. Case, as a matter of fact, is not a relation, but rather a notational device by which the relation is indicated. The notation need not take the form of a word-change, for the relation may equally well be revealed by the position of the word in the sentence or the addition of other words. As a language evolves, case tends to pass from the first form of notation to the second and third forms.

Elements of confusion are to be found even in the most recent text-books. In the older text-books there is a wild riot of parts of speech qualifying, modifying, limiting and governing one another. Adjectives rudely point out nouns, verbs cheerfully carry actions over from subjects to objects, and prepositions act as guides to indicate the relationship between various parts of speech. And if it were contended that to carp at this kind of terminology is the veriest hair-splitting, that everybody knows what we mean by saying that an adjective describes a noun just as everybody knows what we mean by saying that a man is fond of the bottle, I should reply that the one place where a figure of speech is quite inadmissible is in a definition. Here, if anywhere, we must say what we mean with the utmost precision. In parsing it is quite allowable to drop into technical language and to refer to the adjective as qualifying the noun and the adverb as modifying the verb, but in the definition we must speak absolutely "by the card." Besides, the attitude of the grammarian is inconsistent. While girding at slipshod definitions of the adjective and adverb, he himself

stumbles into the same pitfall in defining case, the preposition, and the conjunction.

No, dear Reader, I am not going to attempt to frame definitions myself. I prefer my present vantage-ground. Besides, my business in this place is to prove that the initial stages of the subject present difficulties even to the expert.

Returning to the child, I will give one further illustration of the difficulty he experiences in preserving distinctions which are not to him of practical importance. The boy, to use a fashionable philosophical term, is an out-and-out Pragmatist. In studying Voice we have to maintain a clear distinction between the world of reality and the world of words—between the real happenings and the words which indicate those happenings. Thus we have the two series

Doer, action, sufferer.
Subject, verb, object.

In the attempt to arrive at a definition the attention has to shift about from one series to the other. Those of my readers who have attempted to teach Voice inductively to a class of young children will realise the difficulty to which I refer.

Another consideration which places Grammar at a disadvantage in comparison with physical science lies in the arbitrary nature of its laws. They seem to depend upon a sort of majority vote. There is no inevitableness about them. There is no eternal reason why nouns should have lost their case-endings and pronouns retained them, why the future tense should require two words and the past tense only one, why the past participle of freeze should be formed in one way and the past participle of sneeze in another. They

simply happen so. To Omniscience they are doubtless necessary truths: they *must* be so; to us they are contingent truths: they merely *are* so. They are provisional generalizations which vary with the nationality, and which change as the language grows.

There is, however, one grammatical relation which strikes deeper than all the others. Its roots are to be found in the structure of the mind itself. I mean the subject-predicate relation. It is not merely a grammatical law but a logical and a psychological law as well. Thinking always runs into that particular mould. We cannot help it. It is the way our thoughts march forward, and is the explanation of the fact that discourse is broken up into sentences. To quote Professor Stout, "Sentences are in the process of thinking what steps are in the process of walking. The foot on which the weight of the body rests corresponds to the subject. The foot which is moved forward in order to occupy new ground corresponds to the predicate." This is a law which is independent of race or nationality, and there is much to be said for stimulating the young child early in his career to get the "feel" of the sentence and be able to analyse it into its two essential constituents. This end is best achieved, I think, by starting with his own rambling discourse. He should try to disentangle the separate sentences and put them together in a better form. He would thus gradually acquire a more sensitive appreciation of the points of cleavage between the sentences, without having the current of his thought unduly checked. This seems to me to be a better, because a more natural, method than that commonly adopted of insisting on a young child expressing his thoughts in short, jerky sentences and allowing him

as he gets older to combine them into more complex forms. What though the little girl in her eagerness to tell you about the exciting adventure plentifully interlards her speech with "and," "and so," and "so then"? It is her simple way of expressing the onrush of events. Robbed of these trite connectives, her discourse halts and stumbles, and all its vitality and movement soon disappears. To insist upon formal and stilted sentences at this stage tends to arrest rather than develop linguistic efficiency.

The plea that a knowledge of Grammar is necessary in order that inaccuracies of speech may be explained cannot be supported. The thoroughly ingenuous child, whether he has learnt Grammar or not, always gives the same reason for choosing one of two alternative constructions—the reason that it sounds better. If he has to think of the grammatical rule before he says a thing, by the time he has remembered the rule he has forgotten what he had to say. Indeed a little bit of common sense will go further with young children than a huge supply of grammatical jargon. Let us suppose for instance that a teacher is about to teach his boys the correct use of the combinations "John and I" and "John and me." If he tries grammatical explanations he will find that even after several lessons the boys will be unable rapidly to construct correct sentences containing these phrases. Abandoning Grammar, however, he can in five minutes get them to understand the principle that the correct form when John is absent is the correct form when John is present. We never think of saying: "Come home with I." Neither should we think of saying, "Come home with John and I." As a workable principle this will be found far more

effectual than any grammatical rule. A boy who systematically uses "done" instead of "did" is not helped much by being told that he is using the participle instead of the finite verb. He does not use "broken" correctly because of his knowledge of participles, nor does he use "done" incorrectly because of his ignorance of participles. Correct speech in the young is a matter of imitation. If a boy says "done" instead of "did," it is because he has heard "done" used in this connection more freqently than he has heard "did." "Done" has served his purpose effectively in the home and in the street, it has never brought forth scorn or derision from his companions, and the word has consequently become a fixed mode of reaction. The best way to empty a vessel of air is to fill it with water, and the best way to drive "done" out is to drive "did" in. This is best done by getting the child to construct a number of typical sentences containing the word. It may be urged that in a contest of this kind the school has no chance against the home. To say this is to underrate the influences that the teacher can bring to bear. It is not merely the number of times that a child hears a certain combination of words that signifies: the personality of the speaker signifies too. The instances must not only be counted: they must be weighed as well. When a child admires and respects and loves his teacher a single utterance from him will have more weight, will have greater potency in evoking imitation, than a large number of utterances from one towards whom the child is indifferent. There is, moreover, the teacher's disapproval attached to the wrong usage in contrast with his approval attached to the right usage. These forces fight on the side of the

school. If these fail, then will Grammar surely fail. Vulgarisms in speech cannot be eradicated by pedantries in Grammar.

Suppose a boy habitually says "you was" instead of "you were." The only rational remedy is to discourage the association between "you" and "was" and to facilitate a new combination between "you" and "were." To attempt correcting the blunder by reference to the second person plural of the verb "to be" is to select a roundabout way that many an adult finds difficult, in preference to a short and simple way that a child of two finds easy.

It is open to serious question whether a knowledge of Grammar appreciably improves the composition. The best composition with which I am acquainted is to be found in a school where Formal Grammar has long been abandoned. There is no evidence that it does anything to vitalise the composition in the same way as a generous diet of Stories, Poetry and Literature.

The critics of Grammar as a subject of instruction are of two kinds: (1) The moderate reformers, who would render Grammar strictly subordinate to Composition and would only teach what may be called Applied Grammar. (2) The Whole-hoggers, who would banish it entirely from the Elementary School.

We are all convinced that reform of some kind is necessary, and personally I do not think it matters very much which of these two plans is adopted. One thing is clear. All historical grammar, all grammar that is based either on departed inflections or on analogies with a classical tongue, all grammar that is not inferred from the familiar speech of the pupils, all grammar that cannot be put to immediate use, is

so much educational lumber. It cumbers the ground. I believe that a very simple form of analysis and an untechnical, common-sense type of grammar may be useful in the middle of the school; I believe that a systematic course may profitably be taught by a strong teacher to the top class; but I more firmly believe that if the time now spent over Grammar were devoted to the dramatisation of stories and to fostering a love of literature, our schools would enormously benefit thereby. Content comes before form. Life comes before literature, which we are told by Matthew Arnold is a criticism of life, and literature comes before Grammar, which is in a sense a criticism of literature. A child's eager thoughts are hotly concerned with the drama of life. Literature, which mediates and extends the drama for him, receives much of the warmth of his interest. But Grammar is too remote; warmth is dissipated before it reaches it.

These strictures passed upon Formal Grammar as a subject of study have reference merely to children under thirteen. It by no means follows that it is not suitable for older children. Indeed, I think myself that for youths and maidens in their later "teens" its value as an educational organon is beyond question.

There is nothing wrong with the subject itself: it is the method of teaching it that stands in need of reform. The fundamental fault consists in prematurely forcing grammatical concepts upon the scholars. It is not suggested that teachers nowadays start with the definition; but it *is* suggested that in our anxiety to make rapid headway we do not allow our scholars to arrive at the definition by their own unaided efforts; or, if that is impossible, by their own efforts supple-

mented by a minimum of help. Let us suppose, for instance, that a teacher is about to give a first lesson on "case" to children who can analyse simple sentences. He asks his boys to give him a number of sentences containing the words "I" and "me." He writes these sentences on the board and proceeds to question something after this manner: To how many persons do "I" and "me" refer? (To one and the same person). Then why do we use both words? Can we use "I" only? Can we use "me" only? When must we use "I" and when "me"? This is the crucial question: and here the teacher must be wary. One bright boy gives an answer approximately correct. He says "'I' is used for the subject and 'me' for the object of the sentence." The teacher accepts it and writes it down on the board. This is a false step; not because the statement is incomplete, but because the generalisation has been arrived at by one boy only; and to this boy alone is it of any real value. For a general statement of this kind is, as John Stuart Mill has abundantly shown, but a convenient method of summoning up a number of particular truths which have been grasped in detail. In other words the pupil learns from the particular facts, not from the general statement. The general statement merely reminds him of the particular facts—if he has mastered them. If he has not mastered them it reminds him of nothing: it teaches him nothing: it is simply meaningless. The peculiar value of an exercise of this kind consists in the hunt for the general statement. If he has himself arrived at the general statement, it is conclusive evidence that he has mastered the facts. If he has not reached it himself, to force it upon him is to give him

the shadow instead of the reality. As a gift a general rule or definition is educationally worthless: as a personal acquisition it is real intellectual wealth. Each child in the class should search diligently for the general rule until he finds it. It is one of the main drawbacks of purely oral teaching that the bulk of the children have neither sufficient time nor sufficient stimulus to puzzle out the problems for themselves. The cat is let out of the bag too soon. But why should any lesson be purely oral?

PITFALLS IN THE TEACHING OF ARITHMETIC.

As there is nothing in the material world that does not present a quantitative aspect, the ability to grasp mathematical (including numerical) relations has from the earliest times been regarded as an essential part of the equipment of an educated mind. We are not, therefore, surprised to find the burden of tradition weighing somewhat heavily on the teaching of arithmetic. The newer method of regarding educational problems from the standpoint of the child and the various stages of his development, as distinguished from the standpoint of the adult, has not yet had time to leaven completely the scheme of instruction in this subject. We see in all branches of instruction a tendency to bring the mind of the pupil, in the early stages of his school career, into closer contact with the concrete facts of life, and to postpone to a later period the systematic and formal study of the data there presented. As in the study of English we now regard some acquaintance with literature, and a fair amount of practice in oral and written composition, as a necessary preliminary to the formal study of English Grammar, so are we coming to consider it desirable that the early stages of instruction in arithmetic should be mainly concerned with the application of common sense to the numerical relations of concrete objects with which the child is brought into daily contact. The reasonableness of this order is obvious. Not merely are the stages of development in the child's brain followed, but the knowledge thus acquired is firmly rooted in reality,

and is in vital touch with that system of knowledge which is brought into use in everyday life. So much being premised, we arrive at a consideration of the first pitfall, which consists in a reversal of the order indicated above.

Mechanical Arithmetic.

The first few years of a child's training in arithmetic are often devoted to the mastery of the various "rules" and an undue amount of time is spent in securing accuracy and speed in working abstract examples; while the last year or so is largely devoted to the application of proportion to commercial transactions. To begin with abstract arithmetic and end with applied is a reversal of the natural sequence. Both abstract and applied arithmetic should, of course, come in at all stages: the matter that concerns us here is the relative proportion of each. An undue proportion of mere practice lessons tends to produce an isolated apperceptive system and leads to mechanical results. Accuracy and speed are, of course, desirable, but these can be secured no less by concrete problems than by abstract examples. Hence the skill grows in its natural setting, and the intelligent application of discovered rules follows as a matter of course. Let no man think that mere mechanical skill in computation, and the storing of the memory with the results of arithmetical processes, valuable as they are as time-saving devices, constitute any real progress in mathematical thinking. It was this kind of arithmetic that the "Autocrat of the Breakfast Table" had in his mind when he wrote the following comment on Babbage's calculating machine:—"What a satire, by the way, is that machine on the mere mathema-

tician! A Frankenstein monster, a thing without brains and without heart, too stupid to make a blunder; that turns out results like a corn-sheller, and never grows any wiser or better, though it grind a thousand bushels of them!"

Commercial Rules.

The correlative error is found at the other end of the arithmetic course. Here much valuable time is spent in applying the principle of Proportion to Interest, Profit and Loss, Partnership, Stocks, Discount, and other commercial transactions—time which could be far more profitably spent in a more rigid and scientific investigation of the principles of pure number. Not only is the arithmetic course otherwise seriously truncated, but, without this preliminary training, the rational study of Algebra is impossible. It is beside the mark to say that the principles of notation and of the various rules and operations are studied when they are first used. Much of the earlier arithmetic must necessarily be a matter of rule of thumb. Even the brightest pupils are incapable of giving an adequate explanation of the processes they use. The child of thirteeen is far better prepared to study our system, and other possible systems, of notation than the child of eight; and, unless he is fully aware of the significance of the figures in 237, where the radix is disguised by the device of place, how is he to understand the more flexible algebraic expression $2x^2 + 3x + 7$? There are many teachers who contend that a child of seven should be taught to subtract by the method of equal additions without any attempt to explain the process; but few will deny that children of maturer years should be

set to discover the reason for the peculiar device adopted in this case, and to examine carefully and critically the other rules they have been using. If, for instance, the pupil does not realize that in multiplying 58 by 46 the order of the partial products is merely a matter of convention, how is he to connect in his mind the method of multiplying $5x + 8$ by $4x + 6$ with the method of multiplying 58 by 46, and understand the divergence? When one remembers the mental effort necessary for the clear understanding of the theory of measures, multiples, fractions, ratio, and the equation, no fear need be entertained that the gap made by the ruthless excision of commercial arithmetic cannot be profitably filled.

Purposeless Practical Operations.

Remembering what has been said about the necessity for strengthening the bonds between arithmetic and real life, one cannot but feel that the rapidly growing custom of introducing practical work into the syllabus is in every way to be commended. The introduction of the motor element and the keener interest and fuller sense of reality thereby generated are all so much to the good. A word of caution is, however, necessary. Every teacher who has tried practising his pupils in weighing and measuring with no purpose in view other than that of familiarising them with certain units knows full well how very wearisome such exercises become. The various objects weighed or measured have no necessary connexion with one another; there is no continuity of interest, and no incentive appears for securing exact results. When, however, the weighing and measuring become essential parts of an experiment,

or of some sort of complex process leading to a definite result, the pupil's interest is at once enlisted. The operations in question should, in fact, always serve as means to an end, not as ends in themselves. Among young children, shop-keeping or simple constructive paper work, and with older pupils empirical mensuration with cardboard or simple experiments in physics or chemistry, would render the operations of measuring and weighing purposeful, and invest them with the necessary interest.

Uniformity of Type.

Lack of variety in the exercises set is another fruitful source of ineffective training. The responsibility rests mainly with examiners and text-book writers. For the worst form of this defect we must go back to the days of our fathers when the pupils had to learn the "rule" off by heart and work numerous examples in strict accordance with that rule. A slight advance is made in the average text-book of the present day, where the given type is at least worked out and explained, although the appended exercise still consists of a number of examples to be worked on precisely the same pattern. Some such arrangement as this is to a certain extent inevitable in a text-book which aims at being systematic; for the bulk of ordinary arithmetic problems are reducible to a limited number of types familiarity with which is desirable. But that is no reason why in class-work the pupil should be robbed of the chance of finding out rules for himself; nor is it a justification for setting him problem after problem of the same kind with no fresh appeal to his ingenuity. At the beginning of

the course, at least, the further the class can get away from fixity of type, the more each problem is regarded as *sui generis*, and, the greater the variety of problems set, the more does the teaching make for intelligence. This is one of the respects in which external examinations have exercised a baneful influence. When at a given examination for which the pupils are being prepared, the sums set for many previous years have been of a definite number of definite types, the teacher will very reasonably practise his pupils exclusively in those types. During recent years much improvement is noticeable in the questions set at public examinations, particularly the L.C.C. Scholarship Examinations.

Too much uniformity in the length of the problem set is another defect. Why should the scheme of work be so arranged that the number of sums worked during each lesson should be almost identical? In a test lasting half an hour it seems to be assumed that four or five sums constitute the correct number. Is there anything peculiarly correct and proper in the sum that takes about six minutes to work? There may be some deep psychological reason for thinking that six minutes is the time during which the interest in a numerical problem can be most successfully maintained; but I am inclined to think the reason is to be found in the exigencies of examination. Four sums of equal and moderate difficulty are far more easily examined and marked than eight smaller sums of varying difficulty. One finds no corresponding uniformity in the problems that confront one in real life. I have a marked personal preference for the shorter problem in teaching. Although there is,

perhaps, something to be said for the sustained effort involved in working out a very long example, the disgust the pupil feels when he finds himself lost in a wilderness of figures would probably tend to diminish his interest in the subject. The advantages of the short, concrete problem are numerous, not the least being the large number of ideas brought into use during the lesson. The well-recognised effectiveness of oral arithmetic (wrongly named "mental," since all arithmetic is mental) is due more to the fact that the problems are short and frequent than to any peculiar culture value the exercise possesses. It makes a boy keen, not because it gives him facility in calculation, but because it makes him think—and think "furiously," as the French say. This fact suggests the limit of its usefulness and points out a pitfall. It should be borne in mind that the distinction between oral and written arithmetic is that in one case fleeting images serve as the symbols of thought, while in the other the symbols have the permanency of percepts; in one case the mind is burdened with the results of partial processes, and in the other it disburdens itself on paper whenever it feels the need of relief. The capacity to carry out mentally complex calculations is by no means an essential mark of mathematical ability. Many profound mathematicians lack the gift, which seems to depend partly upon the power of visualisation and partly on a natural aptitude for remembering figures. It is not wise, therefore, to push oral arithmetic to the point of torturing the pupil's mind by urging him to keep fixed on the screen of the imagination a set of figures which keep on dissolving like mist. He is not thereby making progress

in mathematics, but merely giving himself a headache. A bit of paper would save all this. The barrier between oral and written arithmetic should be broken down, and the point of transition from one to the other be recognised as varying with the individual pupil.

Exclusiveness.

While the isolation of arithmetic from the practical side of life often leads to an unintelligent jugglery with figures, its isolation from the other branches of mathematics is equally undesirable, resulting in a loss of effectiveness for each. The incursion of geometry into the arithmetical realm in the way of graphs and mensuration is heartily welcomed by most teachers, but there still remains a reluctance to use algebraic symbols and processes in the arithmetic lesson. Arithmetic must be kept free from adulteration. This is pure prejudice, and, when it is not the result of tradition, arises probably from a misconception of the relationship between the two branches. Just as we find it convenient to abstract from the qualitative differences of objects and deal with abstract number, so do we arrive at a higher generalisation by further abstraction from the abstract numbers themselves. Thus, while from 4 men, 4 books, 4 apples, &c., we get the notion of 4, in the same way from 4, 5, 6, 7, &c., we get the notion of a, b, or x. If the first abstraction is legitimate at an early stage, why not the second? As a matter of fact, the second step cannot be escaped, and it only remains to give it open recognition. The fact may be disguised by verbal equivalents, but the actual process is none the less algebraic. To illustrate by a very simple example: "How much must be

added to 3 to make 7?" Is there any mathematical statement of this problem that is clearer or simpler or more natural than the following: $3+x=7$? The simple equation is, in fact, so potent an instrument in solving problems in number, and is indeed so necessary in dealing with the principles of proportion, that its exclusion from the modern arithmetic course is to me astonishing. It is not without significance to the teacher that the ancients mastered the principle of the simple equation many centuries before they could deal with fractions. The simple equation seems, moreover, to be the natural starting-point for the systematic study of algebra.

Superfluous Rules.

If the doctrine advocated in this paper is a sound one—the doctrine that a training in the Theory of Number and Quantity should consist in an orderly progress from the concrete examples of everyday life to the most abstract principles of algebra—we must regard the arithmetic syllabus as encumbered with a large number of unnecessary "rules." A distinction must be made between fundamental "rules" and other "rules" which are merely practical applications of these. In the text-book Practice is given the same status as Fractions, and Profit and Loss as Proportion. There is, however, an important difference. When a boy who could deal with integers only has learnt fractions he has made real progress along the mathematical path indicated above. When a boy who already knows Proportion studies Interest, he is making no real progress—he is simply marking time. It is, perhaps, necessary that he should mark time;

it is, perhaps, desirable that his grasp of the principle of Proportion should be rendered more complete by practice in the application of the principle. But let not the teacher think that the scholar is making real headway, that he is doing anything more than establishing a position already reached. These "rules," therefore, that are outside the main current of mathematical training may be useful as applied arithmetic; they may be useful in actual life; but they form no essential part of a mathematical course, and as such must be given a subsidiary position. Too much time is at present spent over them, as has already been pointed out in an earlier part of this essay. When they are not of use in practical life they had, probably, better be left out altogether. Real Discount, for instance, is unknown in commercial circles.

The notion of Ratio, instead of being an appendage to the theory of Proportion, should probably be introduced early in the school curriculum, and the theory of Proportion should be developed from the principle of the equation. There is no point in retaining the antiquated form $a : b :: c : d$, since the form $\frac{a}{b} = \frac{c}{d}$ is already familiar to the pupils.

Square and cube root should not be attempted until they have been studied algebraically. Previous to this, these operations are unintelligible and can only be carried out by rule of thumb.

Loose Reasoning.

Precision of thought and statement, which are regarded as essential characteristics of this subject,

are incompatible with such forms as

3 ft. $\times$ 4 ft. = 12 sq. ft. ; 30 cubic ft. $\div$ 6 sq. ft. = 5 ft. ;

$$5 \text{ men} : 12 \text{ men} :: 7 \text{ days} : x, \quad \therefore x = \frac{12 \text{ men} \times 7 \text{ days}}{5 \text{ men}}$$

&c. A gallant defence of the multiplication of concrete quantities will be found in the appendix to Sir Oliver Lodge's "Easy Mathematics"; but, with our present definitions of fundamental processes, the above expressions are inadmissible. They remind one of bygone days when the text-books contained exercises in the multiplication of money by money, ending with the amazing example:

£19. 19s. 11¾d. × £19. 19s. 11¾d.

The result obtained by following the rule given in the book was a source of great perplexity to the thoughtful pupil.

Discouragement of Initiative.

The last pitfall with which I shall deal is one by which all earnest teachers are peculiarly liable to be ensnared—the tendency to do for the pupils what they should do for themselves. This is no Idol of the Cave: it is an Idol of the Tribe. One of the least obvious forms consists in the unvarying distribution of question and answer. The teacher always, either directly or indirectly, sets the problem; the pupil never. Now, it not infrequently happens that more mental activity, and certainly more initiative, is involved in asking a question than in answering it, in setting a problem than in solving it. The pupils should therefore be encouraged to invent problems for solution by the whole class. This tends to make the scholars keen

on their work, and leads to a fuller grasp of the principles involved.

I have indicated above, in a spirit of cheerful dogmatism, a clearly defined view of the form the course in arithmetic should assume. Those who refuse to recognise as such the pitfalls I have pointed out will probably find that they differ from me in the main principles. I will conclude, therefore, by trying to bring those principles more clearly into view.

The arithmetic course should consist of a gradual progress from familiar concrete cases to abstract principles, leading up to the still more abstract science of algebra. This does not mean that there should be no abstract arithmetic at the beginning of the course and no concrete at the close; but that the teacher's main aim should at first be to graft the arithmetic firmly upon the actual facts of life, and afterwards to proceed to the investigation and application of the laws of number. This is the straight path; and, whether it is meant to lead ultimately into the domain of algebra or whether it is meant to terminate before, it is the right path. Those who engage in long side excursions into the realm of applied arithmetic are liable to go astray like lost sheep. Most strongly do I deplore the practice of letting a boy who leaves school at the age of fourteen or fifteen devote a large portion of the last valuable years to the application of principles which he does not understand to commercial transactions which he will never carry out.

In developing systems of knowledge in the child's mind isolation always means weakness. The divorce of school life from home life, and the dissolution of the

natural partnership between arithmetic, algebra, and geometry, are equally regrettable. They lead to looseness of mental grip. Too much time spent in example-grinding to promote facility secures mechanical results at the expense of intelligence.

When the teacher does too much for the child, either in the way of always presenting the "rules" in the form of typical example followed by a string of exercises, or in the way of always setting the problem himself, he is depriving the pupil of some of his right to original effort and tending to promote mediocrity.

The greater variety there is in the examples set, the better. The arithmetic test should, like life itself, be full of surprises. The element of unexpectedness is both a charm and a challenge.

Clearness and precision of thought and statement are essential features of a training in arithmetic.

To promote the complete understanding of the principles of numbers is the main concern of the teacher of arithmetic, and to this must be subordinated all other aims, even that of securing accuracy and speed in mechanical processes; for the system that enables a pupil to compute with ease and think with difficulty stands self-condemned.

THE TEACHING OF ALGEBRA.

I.—Its Connection with Arithmetic.

Algebra may be taught without a text-book; but, as a matter of fact, it never is. The exigencies of school life demand that each pupil be provided with at least a supply of suitable exercises. The teacher thus finds himself in his treatment of the subject largely dependent on the text-books available. He may, and often does, hold views with regard to the pedagogical development of the subject at variance with those of the writers of the books in question; and if he follows the text-book it is merely as a reluctant concession to expediency. Up to quite recently, in fact, the opinion and practice of the best teachers have been far ahead of the text-books. But during the past year there have been placed upon the market about half a dozen algebras which go far to remedy this discrepancy. They are largely the outcome of that growing discontent with the older methods which finds expression in the recent recommendations of the Mathematical Association. The cardinal weakness of the older text-books lies in the almost entire dissociation of the subject from arithmetic; for in this dissociation is to be found the secret of the difficulties the subject presents to young pupils. How serious those difficulties are the reader can realise readily for himself by recalling the time when he first entered upon the study of algebra.

I have no reason to suppose that his experience differed materially from mine. The teachers adopted

none of those devices so cheerfully urged by recent writers on the subject. There was no subtle alluring across the border-line that seemed to separate arithmetic from algebra, so that the unwary pupil might not know that he had entered new territory; no preparatory equipment for travelling in this new country; no hint that the inhabitants thereof would be found to be familiar friends in an unfamiliar garb. It was a stepping forth into the darkness.

We returned from our holidays one morning, and found that we had to start the study of algebra. Boldly we took the plunge, and found ourselves floundering in a sea of unintelligible symbols. Of teaching there was little or no pretence. Each had a text-book—Todhunter's "Algebra for Beginners"—and that must suffice. We attacked the exercises with the usual zeal of novices, contenting ourselves in the main with getting the answers correct; but not entirely silencing the persistent demand of the young mind for some sort of rational explanation. What was the meaning of it all? Had it any practical utility? What was its bearing upon everyday life? It had evidently something to do with arithmetic; but what was the nature of the connection? The result of a sum in arithmetic was an intelligible answer to an intelligible question—a question we ourselves might not inconceivably ask. But in algebra even the question was unintelligible. We could not conceive ourselves as likely to be so circumstanced as to be really concerned about knowing the G.C.M. of $x^3-3a^2x-2a^3$ and $x^3-ax^2-4a^3$.

Apart from the purposelessness of the problems there were other points of obscurity. The symbols

themselves had no more significance than the big A, little a, and bouncing B of our infant days. In the "simple rules," which we worked mechanically, there were evident bonds of connection with the corresponding rules in arithmetic; but, at the same time, there were perplexing points of difference. The absence of carrying, the presence of negative quantities, and the order of attack were constant elements of confusion. At last many of us, I fear, gave up the struggle towards lucidity, and came to regard algebra as a kind of complicated game (not of the most amusing sort), to be played according to certain rules set forth in the text-book, or supplied by the teacher. *E.g.*, "Like signs multiplied together give plus, unlike give minus," was one of the rules. "When you multiply the same letters add the indices" was another. They did not seem to differ essentially from the rules of whist or chess.

In my own case, light began to break in when we arrived at chapter xxi., "Problems leading to Simple Equations." Here at last did I discover that there was some practical value in the symbolism of algebra. Here there appeared some purpose in carrying out operations with quantities which were as yet undiscovered. Nor am I alone in this experience. Others whom I have consulted acknowledge a similar illumination at the same stage. For twenty solid chapters, however, we had been working almost entirely in the dark, and the light to which I have referred did little to illumine the path we had already trod.

Is not this a fairly faithful account of the early stages in the mental history of the young beginner in algebra of thirty years ago? And is the teaching of

algebra much better nowadays than it was then? It is still treated in many cases as an entirely new subject. The algebra lesson is quite distinct from the arithmetic lesson. In some schools, indeed, the course in arithmetic is quite completed before the algebra is begun.

The root of all the difficulties experienced by the pupil is to be found in the failure on the part of the teacher to develop the algebra out of the arithmetic. This seems to me of such vital importance that I may be pardoned for dwelling somewhat tediously upon the matter, pleading for the early inclusion of algebraic symbolism in the arithmetic lesson, and offering a few suggestions to those teachers who, whatever text-book they use, agree with me in thinking that some informal acquaintance with algebra is desirable before a systematic course is taken up.

Algebra and arithmetic are indissolubly one. I am not going to attempt a definition of algebra, but, whatever else it is, it is at least a subsumption and extension of the principles made familiar to the pupil in the study of arithmetic. From no point of view can we regard algebra as having any sort of existence independent of arithmetic. Both sciences deal with precisely the same subject-matter. The difference between them is merely a difference in degree of abstraction; one is on a higher level of generalisation than the other. Two important steps are taken by the pupil in the study of numbers: first the step from concrete quantities to abstract numbers, and secondly the step from abstract numbers to those still more abstract numbers represented by algebraic symbols. Thus if I take 9 from 12 the remainder is 3, whether

the numbers refer to apples or omnibuses. The *kind* of thing is seen to be irrelevant to a mere numerical issue. This is an important advance in the number-thinking of the young child. If we wish the child to concentrate upon the process rather than upon the result, a further stage of abstraction is necessary. $12-9$, $17-1$, $237-26$, &c., may all be represented by $a-b$. Here the actual magnitudes are irrelevant. In the first step he abstracted from the qualitative differences in the numbers and in the second he abstracted from the quantitative differences. Concrete arithmetic, abstract arithmetic, and algebra are all in the same line of advance as we pass through various stages of abstraction. And these processes are inevitably intermingled. There is a constant passing from one to the other. The veriest beginner in arithmetic occasionally thinks in purely abstract terms, and the most symbolic thinker can, if challenged, give as a rule some sort of concrete interpretation to his symbols.

An absurd story is told of an Irishman, who explained his inability to solve the old problem: "If a herring and a half cost three-halfpence, what will a dozen cost?" by saying that he had been trying to figure it out in haddocks. If a person can think numerically in terms of haddocks, he can think equally well in terms of herrings: he is dimly if not fully conscious that the precise kind of thing does not matter. He can easily go a little further, and see that for some purposes even the kind of number does not matter. In this latter case he is really thinking algebraically. From seven men, seven books, seven trees, &c., he arrives at the notion of 7; and from 7, 18, 3, 201, &c., he arrives at the notion of a, b, or x. The child forms

this latter concept much earlier than is generally believed. A distinction must be made between algebraic thought and algebraic expression. When a child thinks of "the product of two numbers"—two unspecified numbers, that is—he is thinking algebraically; when he is able to express that thought in the form *ab* he has made no further advance along the line of abstract thinking—he is not thinking more algebraically than before—he is merely using a more convenient vehicle for that particular kind of thought. For the clumsy symbolism of words he has substituted the more serviceable symbolism of letters. In fact, as soon as a child has mastered the notion of a "rule" in arithmetic he has begun to think algebraically. And since he possesses the thought itself, why withhold from him for so long a period that kind of symbolism which is not merely the simplest means of expressing that particular type of thought, but also the most potent instrument for maintaining and extending it?

The question then arises: When should algebraic symbols be first brought to his notice? A distinction is generally made in the text-books between the letters at the beginning of the alphabet (*a*, *b*, *c*, &c.) and those at the end (*x*, *y*, *z*). The former are said to stand for known quantities and the latter for unknown. That there is a distinction in their general use is unquestionable, although that distinction is not consistently maintained; but surely it is not in any profitable sense the distinction between known and unknown. The quantities are equally unknown in both cases, but in the case of *x* and *y* we want to know what they are, and in the case of *a* and *b* we do not. The real

distinction is one of purpose: the objects of inquiry differ. When we use a, b, or c, the hunt is for a process; when we use x, y, or z the hunt is for a result. When, for instance, I multiply $a+b$ by $a+b$, and show that the product is $a^2+2ab+b^2$, I rest satisfied with this without attempting to fix its quantitative value, even if that were possible. I have shown what operations must be performed with the original terms in order to secure the product. I have, in fact, done nothing more than establish a relationship between the factors and the product in terms of operations to be performed with the given quantities. When, however, I try to solve $2x+3=x+9$, I am searching for an actual fixed numerical value for x. a is an unknown, which I do not wish to convert into the known, because it does not matter; x is an unknown which I do wish to convert into the known, because it is the one thing that does matter. The distinction, as I have already said, does not always hold good. In solving a literal equation, we aim at establishing a relation between the value of x and the value of the other symbols. x, too serves vicariously for the other class of symbols, for we frequently find it used as the radix in that extremely important class of expression based upon the Hindu system of place value; *e.g.*, $4x^3+7x^2+6x+2$.

Having indicated the two classes of symbols—the a class and the x class—we find the object of our inquiry made more specific. We have not only to decide at what stage in the arithmetic course algebraic symbols should be introduced, but also which of the two types of symbols should be taught first. The older text-book answers the latter question in one way, practical teaching experience in another. The text-book deals

with fundamental rules and operations before it touches the equation. And this seems the correct logical sequence. But since the need for symbolisation first becomes obvious in a problem which can be solved by a simple equation, the simple equation is, I submit, the best point of departure for a course in algebra, however simple or however comprehensive that course may be.

Take such a simple problem as this: "What must be added to 19 to make 27?" The simple and natural mathematical expression of this problem is $19+x=27$. Here is a problem the terms of which the pupil can clearly understand. He knows what he is searching for, and when he finds it he will know at once whether it is the thing for which he sought—whether it is the right solution. He is prepared to appreciate any simple device which will enable him to find what he seeks, and will at once see the advantage of using a symbol for the unknown number. The symbolism comes in at the right place—where it is needed. It is a means to an end, and falls naturally into its place as a convenient instrument of thought. The double query can now be answered. The pupil should first become acquainted with algebraic method in the form of the simple equation as soon as he has mastered the four simple rules. I do not mean that the mathematical course should at this point bifurcate into distinct branches, one to be called arithmetic and the other algebra. The pupil should regard x as not even a naturalised subject in the arithmetical realm, but as a native citizen. This citizen should be allowed to multiply freely within the mother country, and only when their numbers threaten to overwhelm their

neighbours should they be drafted off to a separate colony of the name of algebra. Even then there should be frequent commerce between the colony and the mother country.

Other considerations point to the simple equation as the true algebraic starting-point, whether algebra is taught as I suggest, or whether the study of the subject is postponed until the arithmetic course is nearly completed. It is the first form of algebra of which we have any written record. The race found it easier to solve the simple equation than to elaborate a system of fractions; and what the race found easy the individual will not find hard. The personal experience to which I have already referred also points to the equation as the place of greatest lucidity in the course of example-grinding. The equational method will be found to simplify the arithmetic rules, and to be of enormous value in rendering intelligible the principles of proportion. Finally, a complete system of algebraic training may easily be developed from the simple equation, since the problems may be so devised as to involve in their solution any desired operation with the unknown quantity. The pupil should be encouraged so far as possible to infer the rule from the corresponding rule in arithmetic. Each difficulty as it presented itself would thus give rise to an item of knowledge serving as a key to its solution. And knowledge thus acquired is real, vital, and abiding.

In teaching the principles of the equation to young children, the ordinary balance will be found of great service. By simple experiments with equivalent weights in the scale-pans, the axioms may be abundantly illustrated. As an example of the value of the balance

in the solution of a certain class of problems quite apart from the use of symbols, I will instance the following ; not that I regard this particular kind of puzzle as a very profitable means of mental discipline, but because it well illustrates the clearness of thought fostered by the equational method : "If a brick weighs 7 lb. and half its own weight, what is the weight of the brick ?" If this question is put orally to a class of children of about fourteen years of age, the bulk, if not all, of the answers will be $10\frac{1}{2}$ lb. Even when this is shown to be wrong, the teacher will have the greatest difficulty in getting the correct solution. If, however, a balance is brought in, and a brick, placed in one pan, is shown counterbalanced by 7 lb. and half a brick in the other pan, it will seldom be necessary to proceed any further before the right answer is given. Any difficulty that remains may be cleared up by removing half a brick from each pan. It is not, of course, necessary for such purposes of demonstration that actual bricks should be used, nor even the 7 lb. weight, so long as the substitutes reasonably represent the originals.

After the usefulness of x has been fully realised, a kind of exercise which tends to bring the *operation* into clear consciousness should be introduced into the mental arithmetic lesson, ; *e.g.* :—

A man has 3 florins ; how many shillings has he ?
" a " " " " "
" n crowns " " " "
" p half-crowns " " "

How far can I walk in 6 hours at the rate of 4 miles an hour ?
" " " 6 " " a " "
" " " a " " b " "

&c.

Still, the order here indicated, with the cheerful confidence of one who has tried the system, is not of vital importance, and is not, in fact, followed by

the newer algebras, which, however, in each case introduce the equation quite near the beginning of the course.

Although there is a slight difference of opinion to be found in that excellent text-book, "A New Algebra," by S. Barnard and J. M. Child (Macmillan), it is generally agreed that children should be familiarised at an early age with the use of negative quantities. There seems to be a strong prejudice against the use of negative quantities in arithmetic. Even in algebra they were long looked at with suspicion, and not wholly taken into the fold until the days of Descartes. But with the various meanings we can attach to these *numeri ficti* (as they were called in the Middle Ages), there is no reason why a lad who can understand the nature of a debt, the markings on a thermometer, and the simple notion of a straight line having two directions, should not at once commence dealing with negative quantities. Whenever it is found that any device or sign generally monopolised by algebra promotes clearer thinking in arithmetic, the teacher should not hesitate to introduce it. Indices, for instance, are often useful in revealing important relationships.

After graphic illustration of the relation between linear, superficial, and solid units, the children should write out the table thus:

12 in.	= 1 ft.
12^2 sq. in.	= 1 sq. ft.
12^3 cub. in.	= 1 cub. ft., &c.
10 mm.	= 1 cm.
10^2 sq. mm.	= 1 sq. cm.
10^3 c. mm.	= 1 c. cm., &c.

The various powers of 10 should be thoroughly well known, for reasons which will appear presently. The root signs are equally serviceable, although I do

not think that the formal rules for extracting square and cube roots should be taught until they have been dealt with algebraically. There is no reason, however, why the factor method of extracting roots should not be known. Factors, indeed, should be freely employed in finding the H.C.F. and the L.C.M., and in the simplification of fractions.

If the above simple suggestions for enriching the arithmetic syllabus by poaching, as some would think, on the algebraic preserves, are carried out, many of the pupil's difficulties in commencing a systematic course of algebra even on the old lines will probably be found to disappear. In the next chapter I will try to point out what I regard as the weak places in the courses usually laid down.

II.—Defects and Remedies.

In the last chapter I tried to point out that the main weakness of the older text-books on algebra consisted in the failure to develop the subject logically out of arithmetic, and that this weakness was reflected strongly in the teaching of the subject. In this chapter I shall try to show that even the latest text-books, although they indicate a very marked advance, leave something to be desired in the way of grafting the algebra on the arithmetic. I have not yet seen a text-book in which any attempt is made to utilise the beginner's knowledge of our denary system of notation as a basis for explaining an algebraic expression. It is true that after the pupil has had considerable practice in dealing with multinomials, it is shown (generally in a later chapter headed "Scales of Notation") that our denary system is a special case of a more general system; but this surely

is, from a teaching point of view, putting the cart before the horse.

The real significance of an algebraic expression is, I venture to think, seldom or never grasped by the young beginner. Why, for instance, should we ever trouble to express a number in the form $a+b+c$? The number is simple: why should not the symbol be simple too? This is by no means a frivolous question, nor yet a question unlikely to arise in the mind of the pupil. In the mind of the *intelligent* pupil it must inevitably arise. What need is there for a complicated expression like ax^3-bx^2+cx-d? In what conceivable circumstances should we want to multiply this expression by another expression equally complicated? The numbers with which we deal in ordinary life possess no such complexity. All whole numbers, whatever their magnitude, are in a sense equally simple. Each occupies a definite position in the natural number series, 1, 2, 3, 4, 5, &c. Whatever opinion we may hold with regard to the origin of our number concepts, we must admit that this series forms the logical basis of all our operations with number. Every number in that series has its own position and its own magnitude. It is in a very real sense *sui generis*. Its place cannot be occupied by any other number, nor yet by the sum or product of any other numbers. It is absolutely unique.

The captain of a sailing vessel, when going on a long voyage, took out with him a medicine-chest containing remedies numbered from 1 to 20, with a corresponding handbook of diseases indicating the appropriate remedy by number. Remedy No. 9 was soon exhausted, and when the next case of illness called for this particular nostrum the skipper found

himself in a difficulty. But a brilliant idea struck him. He mixed together No. 4 and No. 5. The absurdity of this procedure is obvious; the absurdity of saying that 9 in the number scale is quite adequately represented by $4+5$ is not so obvious. What we precisely mean by saying that $4+5=9$ is that in going up the number series, if, when we arrive at 4, we take as many additional steps as we should have to take to get from the beginning to 5, we shall arrive at 9.

The philosophical reader will remember that Kant deals with this very point in the introduction to his "Critique of Pure Reason." He shows that $7+5=12$ is not a mere "analytical proposition" like $a=a$, but a "synthetical proposition" involving fuller content in the predicate than can be discovered by an examination of the subject. In fact, they are not absolute identities. What I have said of the uniqueness of small numbers is equally true of large numbers: they are merely higher up the series. It is true that small numbers up to 9 are represented by simple arithmetical symbols, while the higher numbers are represented by two or more symbols placed side by side. But the complexity of the symbol is not an essential feature, and in no way affects the simplicity of the number.

Regarded objectively, therefore, there is no essential difference in complexity between a small number like 7 and a large number like 8,263. There seems no reason, then, why each may not be equally well represented by a mononomial algebraic expression such as a, b, or x, and no reason appears for adopting a multinomial form such as ax^3+bx^2+cx+d for the second.

It is only when we come to look at number from the subjective point of view that the real reason for a complex symbolism emerges. Our concept of a small number like five (I am referring, of course, to the psychological and not the logical concept) is simple: it can be imagined in the mind by five dots, five strokes, five fingers, five taps with a stick, or five notes of music; or it may be conceived as occupying a definite position in the series 1, 2, 3, &c. In any case, it can be clearly apprehended by the mind as a single thing. The five dots form a picture easily recognisable without conscious analysis. Of the number 376, however, the mind can form no such simple concept. It cannot imagine the number either visually or aurally; and the only notion it can form of its position in the number series is a very vague one: it is merely conceived as rather high up in the series.

In order to form a serviceable concept of large numbers, we have, in fact, to group them in our minds in accordance with some fixed system. The first group unit in the system in use among civilized races is 10, the second 10^2, the third 10^3, &c. In ascending the number series the termini of the various groups serve as landmarks. It is difficult for us, who were born into a world that had used this system for so many ages that it had come to look upon it as a part of the very nature of things rather than a conventional artifice, to conceive the amount of ingenuity displayed by our remote ancestors in elaborating such a system. The radix 10 was unquestionably chosen because we had 10 fingers on our hands. We find a quinary system of notation, based, no doubt, upon the number of fingers on one hand, in use among the Eskimo, the North

American Indians, and some of the tribes of Equatorial Africa. The Welsh seem to have wavered in the selection of a numerical radix. They have 10 as their first landmark, a subsidiary landmark at 15, and a more stable one at 20. Then the series proceeds by scores up to a hundred. The trace of a vicenary system (where toes come in as well as fingers) is to be found in the Anglo-Saxon use of the word score, as in "three score and ten," and in the French numeral "quatre-vingts." It will thus be seen that we cannot think of high numbers except as the products and sum of simple numbers: we cannot think of 376 except as $3\times10^2+7\times10+6$, or some similar aggregation of groups.

Apart from the psychological limitation we have just discussed, the difficulty of finding a single symbol and a single name for each number is insurmountable, since the series is infinite. The thing is not feasible; nor would it be desirable even if it were feasible, for the concept, the name, and the symbol should have some sort of correspondence. A conventional and arbitrary connection having been established between the numbers, names, and symbols comprised in the first group unit, the correspondence for the higher numbers can no longer be arbitrary. The name five and the symbol 5 were chosen to represent the concept of that number for no irresistible reason inherent in the eternal fitness of things. But this convention once established, there was no option in selecting some such symbolism and nomenclature as 5,555, five thousand five hundred and fifty-five.

Bearing in mind these facts, the reader will, I think, agree with me that a thorough examination of our

system of notation and of other possible ones is an essential propædeutic to the study of algebra. I contend that a child cannot otherwise attach any practical significance to an ordinary algebraic expression. We cannot understand completely anything until we have had some experience of its opposite. Have we not all marvelled at the fact that two and a half centuries ago the world knew nothing of the law of gravitation? If the pull of the earth differed perceptibly at different points of its surface, or if in some parts it was absent altogether, the earliest thinkers would have attempted to formulate the law. But the very constancy and ubiquity of its operation served as a bar to its discovery. The most familiar things are the things we least think about. The child who has for years made practical use of the denary system of notation comes to take the whole thing for granted; he regards it as the only possible system, and seldom tries to understand its structure. It may be contended that in the modern infants' school a sound, fundamental knowledge of the system is given, but experience shows that an average boy of twelve has a very imperfect conception of place value, and would be extremely puzzled if asked to write down 4,004 in figures without using the noughts.

Lessons given at this early stage on scales of notation should not aim at the conversion of numbers from one scale to another, but merely at enabling the pupils to see that a systematic expression of numbers generally takes the form $a+bx+cx^2+dx^3$, &c., written in descending order.

In the common scale of notation $328 = 3x^2 +$

$2x + 8$, $4{,}026 = 4x^3 + 2x + 6$, where the radix or group unit is 10.

$$37{\cdot}625 \text{ metres} = 3x + 7 + \frac{6}{x} + \frac{2}{x^2} + \frac{5}{x^3} \text{ or } 3x^4 + 7x^3 + 6x^2 + 2x + 5,$$

according as we take a metre or a millimetre as our unit. 5 hrs. 26 min. 14 sec. $= 5x^2 + 26x + 14$, where the unit is 1 sec. and the radix 60. These are examples of what may be called systematised numbers. As examples of unsystematised numbers I may instance £4 17*s.* 6½*d.*, which equals $4a + 17b + 6c + 2$, where the unit is a farthing, and $c = 4$, $b = 12c$ or 48, and $a = 20b$ or 960; or 8 yds. 2 ft. 7 in., which equals $8x + 2y + 7$, where the unit is an inch, $y = 12$, and $x = 3y$ or 36. It can thus be shown by examples from ordinary arithmetic that both types of algebraic expressions, the systematised and the unsystematised, have a sound foundation in actual commercial and scientific needs, and were not arbitrarily invented with the sinister intention of making the subject more difficult for small boys.

It is the business of algebra to make the science of number as complete as possible by extending the notions derived from the study of arithmetic. The pupil will accordingly have to deal not merely with positive integral and fractional numbers, but also with negative, irrational, and unreal; not only with a simple decimal radix, but with a general radix of various degrees of complexity. Thus, while the number 59 can be represented by either $5x + 9$ or $6x - 1$ where x is 10, it can be represented by $2x^3 + x + 2$, or by $2x^3 + 2x - 1$, or by $x^4 - 2x^2 - x - 1$, &c., when $x = 3$. The concept of systematic grouping may further be extended to include expressions with a double radix, such as $6x^4 + 7x^3y + 3x^2y^2 + 4xy^3 + y^4$.

It may be noted that it is only in the case of those expressions which I have called systematised that the term co-efficient has any significance. Which, for instance, are the co-efficients in the expression $ab + cd + ef$? In comparing this with the expressions given above as equivalent to a sum of money and a given length, it seems as though one of each pair of factors represents some fixed denomination. There is nothing, however, in the expression itself to indicate that this is the case. The difficulty is still more obvious in the expression $abc + def + ghk$. As a matter of fact, the term co-efficient is extremely useful, but it is only useful in dealing with a certain class of expressions.

A certain marked dissimilarity between arithmetical and algebraic convention should be made clear. Where no operative sign is placed between figures addition is indicated; when no sign is placed between letters multiplication is meant. Thus $3{,}724\frac{2}{3}$ means $3{,}000 + 700 + 20 + 4 + \frac{2}{3}$; but $abcd$ means $a \times b \times c \times d$. This dissimilarity tends to obscure the essential correspondence between the expression of particular numbers in arithmetic and the expression of general numbers in algebra.

The bulk of modern reformers favour Comte's view of algebra as a "Calculus of Functions," and regard the fixing of the idea of function as one of the first steps in the scientific teaching of algebra. The expression $x^2 + 3x + 2$ is considered as a function of x. Its value varies according as the value of x varies. To find that special value of the variable which makes the value of the function zero is to solve an equation. Although it leaves out of account the unsystematised type of expression, this is admittedly a very profitable way

of regarding the ordinary algebraic expression. It lends itself readily to graphic illustration, and leads up to a fruitful theory of equations. But although it in no way conflicts with the view of algebra advocated in this article, it is not, I contend, the best way for a beginner to approach the subject. If the important point were to correlate algebra with geometry, much might be said for laying early stress upon this particular aspect. But the essential thing is to correlate it with arithmetic, or rather to fuse it with arithmetic, for the relationship is too close to be regarded as mere correlation. Apart from the fact that its kinship with arithmetic is more intimate than with geometry, the pupil knows something about arithmetic, but probably knows nothing about geometry. There is no doubt whatever in my mind that the only satisfactory way of treating algebra in the schools is as generalised arithmetic. I am quite prepared to admit that it is something more than generalised arithmetic; but it is that at least, and that first of all. Arithmetic is the soil from which it grows, and if it is to form in the pupil's mind a healthy system of knowledge the teacher must see that the seed is well planted in this soil. It cannot be too often repeated that the one unpardonable defect in the teaching of algebra is to keep these two subjects in disunion. To join it to geometry is well: to join it to arithmetic is indispensable. If the practical teacher wishes to convince himself how detached the two subjects are kept in the mind of the average boy, he has merely to ask him to express the sum, and then the product, of 13×17 and 15×17 in terms of 13, 15, and 17. In the case of $13a$ and $15a$ no hesitation is shown, but when the terms are purely numerical his mental confusion is surprising.

The text-books miss yet another opportunity of a similar kind in neglecting to make clear at the right juncture the close connection between the "four rules" in arithmetic and the corresponding rules in algebra. The process of collecting like terms is one with which the pupil is thoroughly familiar, and should not be sprung upon him as something entirely new.

The teacher, having invested an algebraic expression with meaning, should proceed to develop the algebraic rules for addition and subtraction from the arithmetical rules with which the pupil is already familiar. Let him compare, for instance, these two examples in addition :

235	$2x^2 + 3x + 5$
142	$x^2 + 4x + 2$
21	$2x + 1$
398	$3x^2 + 9x + 8$

Here there is no difference, if we take x to represent 10. In the following, however, we note points of divergence :

58	$5x + 8$
497	$4x^2 + 9x + 7$
609	$6x^2 + 9$
1164	$10x^2 + 14x + 24$

In arithmetic the value of the radix is known, and we can transfer from one denomination to another ; but in algebra the value of the radix is unknown, and each term has to remain in its own compartment. This apparent defect is partly compensated for in algebra by the employment of negative terms. Examples introducing these negative terms will present little difficulty to the beginner who grasps the above comparison.

In subtraction the correspondence between the

algebraic and arithmetical rules may be made equally clear. Thus :

489 163	corresponds to	$4x^2 + 8x + 9$ $x^2 + 6x + 3$
326		$3x^2 + 2x + 6$

When we come to the following example, however, our ignorance of the exact value of the radix forces us to use negative terms.

632 195	corresponds to	$6x^2 + 3x + 2$ $x^2 + 9x + 5$
437		$5x^2 - 6x - 3$

Multiplication presents interesting points of divergence :

67 × 38
38

536 = 8 times 67.
201 = 30 „ „

2546 = 38 „ „

$6x + 7$
$3x + 8$

$18x^2 + 21x = 3x$ times $(6x + 7)$
$48x + 56 = 8$ „ $(6x + 7)$

$18x^2 + 69x + 56 = (3x + 8)$ times $(6x + 7)$.

Here again the unknown value of x prevents "carrying," but the results may be shown to be identical if x is fixed as 10. It will be noted that we find it convenient in arithmetic to commence with the smaller denomination—the units—both in the multiplier and the multiplicand ; while in algebra the conventional method is to commence with what is presumably the larger term. And this is probably what we should always do in arithmetic were we not constrained to

take the opposite course through the necessity for carrying. In the case of the multiplier, however, even in arithmetic we are freed from this constraint, so that the order of the partial products is in both cases a matter of complete indifference. It would be a valuable exercise to work the example given above in the form of $(6x + 7)(4x - 2)$, $(7x - 3)(3x + 8)$, and $(7x - 3)(4x - 2)$, showing that in each case, if x is 10, the result is 2,546.

The correspondence in division may be brought out in the same way. In arithmetic, in fact, we work by the method of detached coefficients, using no negative terms, and, since the value of the group unit is always known to be 10, transferring when possible from one term to another.

Briefly, then, the authors of even the best and latest text-books have missed some of the opportunities of utilising those mathematical concepts which the pupils have presumably acquired in their study of arithmetic.

These slight defects can, however, be easily remedied ; for, however lucid and well arranged a text-book may be, the main task of illuminating the mind of the pupil must ever rest with the teacher.

LONDON:
Printed by McCorquodale & Co. Ltd.